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BINGO

Bringing INnovation to onGOing water management – a better future under climate change

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Short Summary of results (<250 words)
This report gives an overview of the current state of water governance regarding climate change at the six BINGO research sites. The analysis is based on questionnaires among risk owners and stakeholders at the six research sites and two in-depth interviews with experts on national-adaptation policies. The results of the questionnaires and interviews are interpreted using the Three Layer Framework for Water Governance developed by the Water Governance Council. Based on this analysis, strengths and weaknesses of the governance situation are reported for each research site, and suggestions for improvement are offered. Finally, a cross-country comparison of the strengths, weaknesses and improvements is made. This deliverable is primarily used as input for further work in T5.1 and T5.3. The assessment of the current governance situation will be combined with the analysis of adaptation measures (T5.1) to make further suggestions for improvement of water governance at the research sites (T5.3, D5.4(2)).

Evidence of accomplishment
Report

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1. Introduction

This Deliverable is part of the European Union's Horizon 2020 BINGO (Bringing INnovation to onGOing water management - a better future under climate change) project, which runs from 2015-2019. The BINGO project aims to provide better insight into the regional hydrological impacts of climate changes across Europe and to develop practicable solutions for adaptation in these regions. The project focuses on six research sites in six European countries: Portugal, Spain, Cyprus, Germany, the Netherlands and Norway. These research sites represent a huge variety of different geological, hydrological, land-use and governance contexts. The BINGO project will therefore generate insight into common climate change adaptation challenges in Europe, as well as into the context-specific adaptation challenges that face different European regions.

Within the BINGO project, Work Package (WP) 5 aims to develop risk treatment and adaptation solutions for each research site. The work is subdivided into three parts. WP5.1 develops risk treatment and adaptation strategies to deal with the specific hydrological impacts of climate change in each region, identified as part of the BINGO project. These strategies are developed in close cooperation with the local Communities of Practice (CoP's) that have been established at each research site. WP5.2 performs a socio-economic analysis regarding the impacts of these risk treatment and adaptation measures. WP5.3 examines the policy and governance context for adaptation to climate change at the six BINGO research sites. It identifies governance strengths and weaknesses, based on which recommendations will be provided for improvement at the research sites, and beyond.

This document is one of the outcomes of WP5.3. It forms the first part of the Deliverable 5.4, officially entitled: Report on the assessment of the current situation and recommendations for improvement at the research sites using the three layer framework (part 1 M18 and update M46). In this first part, the current governance situation at the six research sites is analyzed: Are climate-related risks sufficiently taken into account in the existing the policy frameworks and to what extent are existing governance arrangements apt to take up new adaptation challenges? The outcomes of this analysis provide insight in the governance challenges for adaptation to the hydrological impacts of climate change per research site.

These results form the basis of the formulation of site-specific recommendations in the second part, where the implementation paths of the adaptation strategies formulated by the CoP's are assessed against their specific policy and governance needs. Considering the governance strengths and weaknesses at the six research sites, which opportunities are provided to implement the measures included in these adaptation strategies, and where are potential hindrances? This assessment will form the second part of Deliverable 5.4, which will be completed in project month 46.

The report is structured as follows. Chapter 2 outlines the theoretical framework used for the analysis and explains the data collection methods. Chapters 3-8 describe the findings of the governance analysis per research sites. Chapter 9 makes a comparative analysis as a main conclusion.

2. Theoretical framework and data collection methods

2.1. The Three Layer Model as the theoretical framework used

For the analysis of governance needs per adaptation measure, we use the **Three Layer Framework for Water Governance** (see Figure 1). This framework, designed by Havekes et al. (2013), was developed against the background of increased experiences with water-related stresses around the world. According to the World Economic Forum's Global Risks Assessment, water problems are one of the biggest future threats facing humanity (World Economic Forum 2015). In the United Nations Office for Disaster Risk Reduction (UNISDR) floods and droughts rank in the top 3 most experienced climate-related disasters between 1980 and 2011[1]. The UNISDR's Global Assessment Report of 2015 emphasizes that dealing with these hydrological impacts of climate changes requires more than a governmental and top-down technical approach. Just as important as technical solutions are good governance practices that provide the necessary legal, financial and administrative capacities to implement adaptation measures and ensure a sufficient amount of stakeholder participation and public accountability to safeguard the legitimacy of adaptation efforts. The Three Layer Framework for Water Governance was developed as a tool for assessing water governance practices against these general values.

Figure 1 – The Three Layer Framework

The framework builds on the work done by the Organization for Economic Co-operation and Development (OECD 2011) on governance gaps in water governance, and elaborates on these gaps with the building blocks for good water governance identified by the Dutch Water Governance Centre (WGC 2011). The framework distinguishes between three layers of governance. First, the "content" layer looks into the substance of adaptation policies. Through this layer, adaptation policies are characterized by their degree (are relevant climate-related risks addressed in the policy framework, or do certain risks remain untreated?) and nature (e.g., do adaptation policies rely on technical, legal and/or financial policy instruments?). In addition, the content layer assesses the available expertise and skills needed to develop relevant adaptation

[1] https://www.flickr.com/photos/isdr/7460711188/in/album-72157628015380393/

policies in a governance context. In this report, this is further specified in terms of information about the regional impacts of climate change and knowledge about possible coping strategies to deal with these regional risks.

Second, the "institutional" layer deals with the organizational aspects that support the effective implementation of designed adaptation policies. In the Three Layer Framework, good institutional capacities entail clear and legally anchored divisions of responsibility, strong legal and administrative capacities (which for example includes workforce (fte), management and supervisory qualities, implementing capacities, monitoring capacities) and a robust financing structure.

The third "relational" layer of the framework refers to the requirements placed on the wider governance context of adaptation to climate change. The Three Layer Framework makes a distinction between culture and ethics, communication and cooperation, and participation in this regard. In this report, this is further translated into the extent to which developed adaptation policies establish links between different sectors, the extent to which adaptation governance is clear and open to the public, and the extent to which stakeholder participation is realized in regional governance contexts.

This framework is applied in all WP5.3 governance analyses to facilitate mutual comparisons. For example, the framework is also used to analyze the governance needs of the selected adaptation measures per research site, which is part of Deliverable D5.1: Portfolio of risk management and adaptation strategies available for the six research sites in BINGO. By linking the governance needs of different adaptation measures to the governance challenges identified through the analysis in this report, potential 'bottlenecks' may be identified for the implementation of certain selected adaptation measures in specific regional contexts.

2.2. Data collection method

Data for this analysis was collected in two steps. First, questionnaires on policy and governance were sent out to (CoP) stakeholders; the replies provide information on the policy and governance context at the six BINGO research sites. This allowed to identify site-specific policy and governance needs for adaptation to climate change in different sectors that are impacted by climate change. Annex I contains the questionnaire template. In the table below, an overview is given of the number of questionnaires collected per research site.

Table 1 – Questionnaires per research site

BINGO research site	Number of questionnaires	Sectors involved
Cyprus/Troodos Mountains region	6	Public administration, public water supply, agriculture, waste water.
Portugal/ lower Tagus transboundary river basin	10	Public administration, public water supply, agriculture, waste water, research.
The Netherlands/the Veluwe	6	Public administration, public water supply, water resources management, spatial planning.
Germany/Wupper River Basin	11	Public administration, water resources management, public utilities (water supply and treatment, energy).
Norway/Bergen city	5	Public water supply, research.
Spain/Badalona city	9	Public administration, public water supply, waste water, spatial planning, beach management, research.

Second, two in-depth interviews with national-level policy experts were conducted at every site to generate insights into the national-level policy and governance context that influences adaptation efforts at each research site. The expert-interviews were held with (1) a key policymaker and (2) a key scientist working on national adaptation policy in the six countries. Annex II contains the interview protocol. The table below lists the organizations interviewed at each site.

Table 2 – Expert-interviews per research site

BINGO research site	Expert-interview 1	Expert-interview 2
Cyprus/Troodos Mountains region	Senior hydrologist at the Water Development Department	Civil and environmental engineer at the Institute of Environment and Sustainable Development
Portugal/ lower Tagus transboundary river basin (I)	Professor at the University of Coimbra, researcher at the Centre for Social Studies (CES)	Former head of the Tagus River Basin District Administration Division
Portugal/ lower Tagus transboundary river basin (II)	Water resources expert consultant and former President of the Institute for Water (INAG)	Principle researcher at LNEC and former President of the Portuguese Regulatory Authority on Water and Waste services (ERSAR)
The Netherlands/the Veluwe	Researcher at the Public Administration and Policy department of Wageningen University & Research	Policymaker at the Dutch Ministry of Infrastructure and the Environment
Germany/Wupper River Basin	North Rhine-Westphalia State Agency for Nature, Environment and Consumer Protection (LANUV)	Wupperverband – Department of Forestry
Norway/Bergen city	Researcher at the Regional Climate & Climate Services and Climate Dynamics departments of Uni Research,	Policymaker at the Norwegian Environmental Agency
Spain/Badalona city	Researcher at the Institute of Science and Environmental Technologies (ICTA) of the Autonomous University of Barcelona (AUB)	Spanish Office of Climate Change (OECC) of the Spanish Ministry of Agriculture, Fishing, Food and Environment (MAPAMA)

The interviews were conducted by the local project partners. According to the BINGO ethical code, the interviewees are listed according to their professional contacts (name, organization) only. The expert-interview summaries were sent back to the respondents for a final check to make sure that the report adequately captures the respondent's insights and ideas. The interview reports were not made public to maintain an open interview setting, but their results have been incorporated in this Deliverable.

Both the questionnaires and the interview reports were translated into English by the local project partners, complemented with a first analysis of the meaning of these results in the regional governance context. The questionnaires and interviews were further and systematically analyzed in terms of the Three Layer Framework by the WP leader (KWR). Each of the analysis chapters has been send back to the local project partners for review. Based on these regional governance assessments, conclusions have been drawn about general and site-specific governance strengths and weaknesses across the European regions studied in the BINGO project.

3. Cyprus – The Troodos Mountains region

3.1. Introduction to the area[2]

This chapter describes the findings of the policy and governance analysis for adaptation to the hydrological impacts of climate change in the Troodos Mountains region, the BINGO research site in Cyprus. This region covers roughly 60% of the island and contains the Cyprus' main water resources. In the Troodos region, the BINGO project focuses on the downstream area of the Peristerona watershed. The findings of this analysis provide information on policy and governance strengths and needs for adaptation to climate change in the region.

Being a Mediterranean country, water scarcity has posed a persistent risk to Cyprus' water management for centuries. For the Peristerona watershed, climate change may increase this risk. The prolongation of dry periods may lead to a depletion of water resources in the future; groundwater levels could fall and existing boreholes could dry out. Especially the Kato Moni community could experience the consequences of climate change in this regard, because its current water resources just match the local demand. However, climate change also poses new risks to the region, such as floods and a deteriorating quality of water resources.

The research for this analysis was coordinated by the Cyprus Institute (CYI). The table below lists the respondents that filled in the questionnaire and the experts that were interviewed.

Table 3 – Overview of respondents in Cyprus / the Troodos Mountains region

Organization	Respondent
Questionnaires	
President of Orounda Community Council (Domestic Water Supply)	Sotiris Hatzidemosthenous
President of Kato Moni Community Council (Domestic Water Supply)	Charalambos Matsoukas
President of Peristerona Community Council (Domestic Water Supply)	Michalakis Fotiou
Manager/bookkeeper at the Irrigation Divisions 'Domes' & 'Naos', Peristerona	George Yiorkadjis
Manager/bookkeeper at the Irrigation Division 'Kampos tou Mylou', Peristerona	Andreas Christoforides
Vice-President, Sewage Board of Astromeritis – Peristerona – Akaki complex	Aris Constantinou
Expert-interviews	
Senior hydrologist at the Water Development Department	Charalambos Demetriou
Civil and environmental engineer at the Institute of Environment and Sustainable Development	Maria Zachariou-Dodou

[2] A more elaborate description of the research site can be found in D3.1 of the BINGO-project

3.2. Content layer

Content of policy framework

Because water scarcity has been a prominent concern throughout the history of Cyprus, most national-level legislation addresses the availability of water supply for different purposes. For example, the Water Protection and Management Act of 2004 and the Integrated Water Management Law of 2010 aim to make sure the country's water resources are well-managed to sustain its contemporary uses, in line with the relevant EU-legislation, mainly the Water Framework Directive (WFD). Cyprus is currently preparing a National Adaptation Strategy, which will provide guidance on how to deal with the hydrological impacts of climate change.

In the Peristerona watershed specifically, three subdomains of water governance can be distinguished: domestic water supply, irrigation, and wastewater treatment.

Domestic water supply is effectively regulated. The supply relies on groundwater resources, which are managed by community councils, who are also responsible for the provision (distribution and selling) of water to households.

Water for irrigation comes from boreholes and is distributed to users through local infrastructural (pipe) networks which are operated by pumps. Water is also diverted from the ephemeral Peristerona River and flows by gravity through a network of open, concrete channels. In dry years there is no surface water for irrigation in the downstream communities (Peristerona, Astromeritis) and little in Orounda and Kato Moni. Water supply for irrigation purposes is regulated through the Irrigation Division (villages) Law Cap. (chapter) 342. This law arranges that a group of ten or more landowners can form an irrigation division to share amongst themselves the resources and costs of irrigation water supply, for which they lay down rules in an agreement. Apart from groundwater boreholes managed by irrigation divisions there are also boreholes exploited by individual farmers.

A relatively new subdomain of water governance in the Peristerona watershed links to waste water treatment. Recently, a sewage water treatment plant was constructed in the region by the central water management authority, that is the Water Development Department (WDD). This plant collects wastewater from three adjacent communities of Astromerites, Peristerona and Akaki. The sewage systems of these communities are connected to the waste water plant by a series of newly constructed wastewater pipelines. The treated wastewater will be used for irrigation purposes.

Information on impacts of climate change

In general, the respondents indicate that water management in the region is backed by sufficient information. The impacts of climate change on the temperature, rainfall patterns, water availability and floods are generally well-understood. However, more information could be generated about the impacts of climate change on the quality of water resources and related health issues.

However, respondents also indicate that day-to-day management practices (both for domestic supply and for irrigation) are largely based on empirical knowledge. This means that there are limited institutional arrangements and advanced structural tools to ensure that knowledge about the possible long-term impacts of climate change are taken into account in actual water management practices. Mostly, the policy framework focuses on sustaining existing water uses and addressing current water scarcity problems.

For example, domestic supply systems have no leak-detection system Setting up such a system requires high investment costs. Regarding irrigation supply that relies on groundwater, there is little information available on the water level of the aquifer in (specific areas of) the region. Because water use for irrigation is not centrally monitored, there is little insight into the effects of irrigation on the groundwater level in the area. Although water abstraction by irrigation divisions is metered, the water fees charged (and checked by the District Administration officer) are typically estimated on the energy (hours of pump operation) cost, i.e. billing is not based on the volume of water consumed.

Knowledge of possible coping strategies

At the national level, as becomes evident through the expert-interviews, the impacts of climate change are primarily addressed by tailoring existing policies on water scarcity to newly anticipated drought scenarios. For example, desalination plants have been effective in securing the domestic water supply and such plants are now forwarded as an adaptation strategy as well. In the agricultural sector, technological innovations, such as drip irrigation systems, have been implemented for many years and are effective in improving irrigation water use efficiency; such systems are also included in the National Adaptation Strategy that is currently being developed at national level.[3] The government already used pricing schemes to encourage end-users to reduce their water use. Such price incentives are now also included as a conservation tool in national adaptation strategies and visions.

However, in addition to integrating successful existing policies into a national adaptation strategy, new policies have also been devised. These policies deal with the new risks posed by climate change. In 2010, for example, a Flood Risk Law was adopted.

The three communities located in the downstream part of the watershed have already implemented measures to deal with potential depletion of their (drinking) water resources during prolonged periods of drought. The Kato Moni community has constructed two household water supply systems, one for drinking water and one for garden irrigation, to deal with this risk. The Peristerona and Orounda communities have prepared back-up solutions (additional boreholes) to ensure the water supply in dry periods. In Kato Moni, community leaders are also thinking about long-term strategies to deal with droughts under extreme climate scenario's; they are for example exploring the possibilities of connecting to nearby water distribution networks to absorb the shocks produced by major inflow reductions.

In the case of irrigation, there is much less planning for adaptation to climate change. The stakeholders involved in the survey and interviews did mention a lot of potential options in this regard. Suggestions include better maintenance of check dams (e.g. timely removal of accumulated sediment), improvement of the financial management of irrigation divisions to contribute to a better management of (ground)water resources, and merging pipe networks of different irrigation divisions to absorb fluctuations in groundwater resources. However, as to yet, these options have not been implemented.

The Astromerites-Peristerona-Akaki sewage treatment plant has been developed as a requirement for the European Urban Waste Water Treatment Directive (91/271/EEC). The treated sewage water can be used for irrigation, as a coping strategy to deal with the impacts of climate change. These non-conventional water resources can provide an alternative supply solution for irrigation purposes.

[3] The status of the National Adaptation Strategy can be found at: http://climate-adapt.eea.europa.eu/countries-regions/countries/cyprus [December 15, 2016].

3.3. Institutional layer

Roles and responsibilities

In general, water management in the Peristerona watershed is backed by strong legal arrangements. Most responsibilities are governmental. They have been clearly defined and legally anchored in the Integrated Water Management Law. Various Departments of the Ministry of Agriculture, Rural Development and Environment take on a large share of the responsibility for climate adaptation in particular.

For domestic water supply, the division of responsibilities is generally clear. Community councils are legally responsible for selling and servicing water supply to households through the Communities Law 86(1), which falls under the authority of the WDD.

In case of the governance of water use for irrigation, responsibilities are less clear. Irrigation divisions are governed by a committee that sees to the allocation of water among the different users. The members of each irrigation division elect a cashier/manager, who is responsible to collect the irrigation fees from all members and ensure the smooth functioning of the irrigation network. Irrigation divisions are chaired by a District Administration officer who checks the financial status of each division on an annual basis.

However, central and regional responsibilities intersect and sometimes overlap in the case of irrigation. For example, while the check dams, small, often temporary, dams that are constructed in rivers to counteract erosion and improve groundwater recharge, are state property and the WDD is responsible for their maintenance, some irrigation divisions intervene in this task by independently cleaning the deposited sediment. Also, there are no quotas for groundwater extraction for irrigation, and this use is also not monitored. If this would be included in a law or regulation, it would provide the WDD with the opportunity and authority to ensure a sustainable use of groundwater through a quota policy.

Comprising a new subdomain in Peristerona's water governance, roles and responsibilities for waste water treatment have only been specified at the operational level. While the WDD set up the waste water treatment plant, its operation is subcontracted to a Sewage Board. This board consists of two members of each of the three communities that are connected to the plant and is chaired by a District Administration officer.

Administrative resources

According the questionnaire respondents and interviewed experts, existing water management practices in the region are supported by adequate legal and administrative resources. That is, current responsibilities for water management in Peristerona rely on strong legal and administrative arrangements that allow responsible actors to effectively act according to their assigned responsibilities. Responsibilities are connected to clearly outlined targets for different governance actors. In addition, there are sufficient resources for monitoring and compliance these targets at the central level.

For domestic water supply, quality standards are in place and quality checks are performed regularly (at least once a month) by the national government's Public Health Services Department of the Ministry of Health. Moreover, communal groundwater extraction policies are supported by the Geological Survey Department. The pricing structure for domestic water supply is overseen by the District Administration and drinking water prices are approved by the WDD at the central level.

Administrative resources for irrigation vary greatly between irrigation divisions. Within irrigation divisions, costs for the construction and maintenance of irrigation networks are shared according to use. For this, the hours of abstractions per farmer are recorded. It is the task of the bookkeeper/accountant to make sure that all costs (in a strict financial sense, environmental and resource management costs the EU Water Framework Directive calls for (article 9) are not included in those calculations) are recovered from members of the division. Well-organized governing committees have the capacity to oversee the irrigation uses of its members and allocate water use between them based on a consideration of individual needs and the hydrological status of the system (e.g., in dry periods the committee can allocate water use differently to counteract drought). However, the questionnaire and interview respondents also note that some governing committees lack sufficient administrative and organizational resources. In these cases, groundwater extractions are not always monitored and little managed. Overall, while the irrigation divisions are chaired by the District Administration, pricing is based on time rather than volume and groundwater is also abstracted for individual irrigation use. According to the respondents, this context presents a challenge for setting up an effective regional oversight and coordination system for managing groundwater resources.

Respondents also argue that resources sometimes lack for the implementation of policies. This is particularly problematic for the implementation of new climate change adaptation policies. For example, while national-level policies outline the importance of drought-tolerant crops to ensure the availability of water resources in the future, no means are designed to actually "compel" famers to change crops. Although farmers are encouraged (through subsidy incentives) to grow drought-tolerant crops, governmental departments cannot impose the cropping choice decision to farmers. Another underlying cause of this problem may be that while the Environmental Department oversees and coordinates adaptation policies, it is not responsible for the implementation of these policies. In the case of water management, this responsibility belongs to the WDD.

Financial resources

Financial support for domestic water supply in the Peristerona watershed is sufficient/well-arranged according to the respondents. Large investments for infrastructure (e.g., for the renewal of pipe networks) are sponsored by public funding. Governmental regulation 128 (2014) requires prices for domestic water to cover all costs of the production and delivery process, which includes not only financial but also environmental and resource-related costs (according to the WFD). Water supply to households is metered and charged accordingly; households receive 3-month bills where volumetric block-pricing is applied to incentivize water conservation.

The situation is different in the subdomain of irrigation. Although water metering of groundwater abstracted by irrigation divisions is required, water is charged by time rather than by volume, as pricing is mainly based on the electricity costs to operate the pumps. This means there is little control on the actual abstraction of groundwater for irrigation purposes. The financial structure underlying the use of irrigation water can be somewhat unreliable, because this structure is highly dependent on the organizing and management capacities of the governing committees of local irrigation divisions that charge bills to end-users and manage the costs of the irrigation system. Especially in 'bad years', end-users may not be able to pay their bills in time, which means the irrigation division has to build up sufficient financial reserves to absorb such blows. A related challenge concerns the maintenance of irrigation systems; in some divisions, this maintenance is challenged by delayed bill payments.

For the treatment of sewage water, the installation is still in its infancy. The wastewater treatment plant itself has been built but not all households are yet connected to communal sewage systems that are linked to the plant. Therefore, some households are not charged, While a proper pricing and management system has been set up, it still needs to be implemented.

The costs of climate change adaptation solutions are potentially very high. For example, a pipeline could be built from desalination plants to the Peristerona communities to address water shortages in this region. However, the initial investment costs of such infrastructures are very high. Up to now, it is not clear who will pay for these costs.

3.4. Relational layer

Links to other policy sectors

According to the respondents, water scarcity presents a shared problem to the development of important economic sectors in Cyprus. Agriculture, tourism, environment and energy all depend on a stable water supply. Because of the long history in dealing with water scarcity, strong links between these sectors have grown. With the transcription and implementation of the EU Water Framework Directive in national-level policy, collaborations between these sectors have even intensified.

In the Peristerona watershed, water management for domestic water supply is therefore strongly interlinked with spatial planning. However, respondents note that the management of water supply for irrigation operates rather independent from other policies. While in practice this area is linked to the agricultural sector (e.g., through per hectare subsidies), strategic links between both sectors have not been made. Sewage water treatment is strongly linked to environmental protection laws.

Transparency and public accountability

Respondents generally feel that the goals of water management, the roles of different parties, and the rules that guide their actions are sufficiently clear to stakeholders and the public. This transparency creates confidence for collaborative work.

However, accountability for adaptation responsibilities is much lower; while adaptation policies have been outlined, it is unclear who can be held responsible for the (effective) implementation of these policies.

Participation

According to the respondents, relevant stakeholders are sufficiently involved in the governance of domestic water supply and sewage treatment. However, some respondents also note that these stakeholders mostly belong to ‘organized’ entities in the public sector (e.g. governmental bodies). The private sector and end-users (households themselves) are involved much less. Because of this lack of stakeholder participation, the awareness of climate change and their potential role in adaptation solutions is generally low among end-users. For example, households and farmers decisions have been rather unresponsive to changes in water prices – a national-level policy strategy for adaptation – so far. A hindrance to organizing stakeholder involvement is the lack of relevant organized citizen groups or stakeholder organizations that can be involved in policy consultation processes. An underlying problem may be that adaptation policies do not take social or equity issues into account, because of which this policy field remains rather technical and top-down regulated.

Interestingly, in the subdomain of irrigation governance, end-users are actively involved in the management of their own water resources through irrigation divisions. In their activities, they collaborate with regional government authorities (e.g. the District Administration officer).

3.5. Governance strengths and weaknesses

Strengths

Different strengths of the policy and governance framework for adaptation to climate change in the Peristerona watershed can be found in each layer of water governance. Water governance in Cyprus is guided by a clear and legally embedded policy framework, which is based on a good understanding of the contemporary condition of the water system. This is reflected in a strong institutional capacity. Roles and responsibilities for daily management practices are clearly defined and divided between different authorities. Also, the necessary reporting requirements have been set up to ensure accountability. In the governance of domestic water supply, administrative and financial resources are well-arranged. While administrative and financial resources in the subdomain of irrigation are relatively less organized, end-users are actively involved in water governance. This facilitates the development of governance solutions that are tailored to the specific needs of end-users in a certain area.

Weaknesses

Weaknesses of the governance context for adaptation to climate change in the Peristerona watershed are also located within all layers of water governance. The content of the policy framework is focused on the contemporary situation, not taking long-term developments such as climate change sufficiently into account. Daily management is largely based on empirical knowledge and solutions are based on insights about what works and does not work in practice. While the impacts of climate change are well understood on a general level and the first adaptation measures are already in place, the impacts are only known crudely. Because of this, adaptation is mainly incorporated under existing policy approaches (dealing with droughts for example) but new risks remain under-addressed. As a result of this lack of understanding about detailed impacts, the policy framework for adaptation is not accompanied by clear institutional arrangements. It is for example not specified who is responsible for anticipating which impacts, who is responsible for taking precautionary (e.g., who will pay for the infrastructural improvements in the domestic water supply and irrigation networks) and emergency (e.g., who is responsible for ensuring the water supply in cases of prolonged drought) measures, and who will carry the burden of potential negative consequences (e.g., higher drinking water prices, crop damages) caused by the impacts.

Governance needs (what can be improved)

To improve the current situation, more knowledge could be generated about the specific and regional-level impacts of climate change on the local water cycle. However, in order to fully grasp these impacts, a better understanding of interactions in the local water system is needed. In the current situation, surface water diversions and groundwater abstractions are for example not always sufficiently monitored, and because of this, the consequences of these abstractions on groundwater levels – which will interact with the impacts of climate change – are not known. More insight into these kinds of interactions will help to develop robust policy solutions for adaptation to climate change.

In addition, the institutional arrangements supporting these policy solutions could be improved. Roles and responsibilities of different parties have to be clarified, to make sure that every party is aware of its responsibility for taking precautionary, emergency and coping measures, and can be held into account for acting on this responsibility. While such institutional arrangements could potentially develop in the subdomain of domestic water supply as this domain is already characterized by a strong institutional framework, they could be harder to develop and implement in the subdomain of irrigation governance because the financial and administrative arrangements in this subdomain are more fragile. At the same time, the governance structure in the irrigation subdomain does display an important quality for adaptation to climate change, that is, a decentralized responsibility structure (with irrigation divisions) in which end-users participate and through which policy solutions can be generated based on the specific characteristics of an area. Such solutions are generally seen to be of great importance for adaptation to climate change, which has different impacts at different localities and therefore requires the development of tailor-made solutions by involving stakeholders in the policymaking process. This mode of governance also allows to develop more (strategic) linkages with other sectors.

4. Portugal – the Lower Tagus Transboundary River Basin

4.1. Introduction to the area[4]

The research site in Portugal focuses on water systems from the lower Tagus transboundary river basin.

The system includes the Zêzere river basin, where an important water intake for public supply exist in the Castelo do Bode reservoir, the lower Tagus river and upper estuary; with Valada and Conchoso water intakes (respectively for public water supply and for agriculture), the Sorraia basin, another Tagus effluent, where an important irrigation perimeter exist, and the Tagus river related aquifer systems. These are intensively used and constitute a legal vulnerable zone, conditioning agriculture practices.

More than 3 million inhabitants and extensive areas of agriculture are served by these water resources. Water supply, agriculture and hydropower compete for water uses in a scenario that combines a history of serious riverine and estuarine floods and droughts, and the potential for salt water intrusion from the Tagus estuary.

Climate scenarios point out risks of prolonged drought, with the reduction of inflows. The drought periods also increase the risk of forest fires. Rising temperature can lead to a decrease of water quality. Finally, an increasing flood risk that can damage infrastructure is expected. Erosion of river banks and intrusion of salt water are also mentioned as potential future risks.

The case study addresses the climate changes adaptation of the public water supply and agriculture sectors in the region, and how water resources management affects it. International basin sharing with Spain is also a relevant issue.

The Portuguese case study addresses the adaptation of the public water supply and agriculture sectors to climate changes concerning the features related to water resources, either as raw material (for drinking water production or irrigation) or as receptor of wastewaters. Therefore the water resources governance analysis is affected by this sectorial perspective.

[4] A more elaborate description of the research site can be found in D3.1 of the BINGO-project

Table 4 – Overview of respondents in Portugal / the Lower Tagus Transboundary Tiver Basin

Organization	Respondent
Questionnaires	
EPAL	Basílio Martins, Ana Luís
Associação de Beneficiários da Lezíria Grande de Vila Franca de Xira	Ana Geraldes
CAP – Agricultores de Portugal	Alexandra Brito
DGADR - Direção-Geral de Agricultura e Desenvolvimento Rural	Alberto Freitas and Pero Brito
Direção Regional de Agricultura e Pescas de Lisboa e Vale do Tejo	Paula Guerra e Ilídio Magalhães
CIMLT – Comunidade Intermunicipal da Lezíria do Tejo	Ana Garcia e Natasha Oliveira
Águas do Ribatejo	Anonymous
SMAS de SINTRA	Anonymous
CES - Centro de Estudos Sociais da Universidade de Coimbra	Alexandre Tavares
ARH_TO Administração da Região Hidrográfica do Tejo e Oeste	Maria Helena Alves
Expert-interviews	
Former head of the Tagus River Basin District Administration Division	Helena Alves
Professor at the University of Coimbra, researcher at the Centre for Social Studies (CES)	Alexandre Tavares
Water resources expert consultant and former President of the Institute for Water (INAG)	Pedro Serra
Principle researcher at the National Laboratory of Civil Engineering (LNEC) and former President of the Portuguese Regulatory Authority on Water and Waste services (ERSAR)	Jaime Melo Baptista

4.2. Content layer

Content of policy framework

The Water Law, and related legislation, is the legal instrument ruling water management in Portugal, resulting from the transposition of the Water Framework Directive (WFD) into national law. It provides the objectives and planning principles and frames a set of planning instruments that intend to support the achievement of environmental improvement of the status of water bodies and allows integrated water resources management in the region. At the national level, the National Water Plan (PNA) provides the framing objectives. At the regional level, the Tagus River Basin District Management Plan (PGRH) includes measures to improve the status of water bodies.

There are also plans for specific regional units (e.g. reservoirs protection – Land and Water Reservoir Management Plans), or for specific thematic purposes, as for example, the National Plan for Efficient Use of Water (PNUEA) or for climate adaptation (National Strategy for Climate Change Adaptation – ENAAC).

Water resources management in Portugal is performed at public/administration level, with a regulatory, top-down character. Being essentially the transposition of Water Framework Directive, the Water Law provides

the framework, but lacks the necessary policies, strategies, means and mechanisms to implement it, in order to achieve the environmental objectives and a sustainable, balanced and equitable water use.

As examples the lack of water uses policy, as well as specific water policy guidelines for strategic options regarding priority intervention in the water domain are mentioned. A conducting line guiding on how to jump from the legal framework to the concrete implementation is missing as well.

Due to the legal European framework prior to WFD, some mechanisms to prevent pollution are already in place in Portugal, but the lack of water uses policy and adequate implementing mechanisms didn't yet allow Portugal to embrace the WFD challenges and paradigm to achieve a sustainable, balanced and equitable water use, while achieving environmental objectives.

Mechanisms to deal with extreme events exist, mainly floods but also droughts up to a certain extent. Water resources management in Portugal is essentially oriented at pollution control and emergency management. General practice is focused on immediate management priorities and not on long-term planning.

Being considered by some respondents as complex and abstract, water legislation in Portugal could benefit from simplification and harmonization, for instance the codification of all the legislation into a single Water Code, less persecutory and more conciliatory. It should also be complemented with specific and clear water implementation policies and strategies, allowing to step forward from the general framework to real water resources planning and management practices.

Water uses policy (hydropower and others) is considered to be a very relevant missing component of the management process that should be based on an improved economic analysis of water (recognizing the economic, social and environmental importance of different types of uses). It would provide the basis for accordingly reviewed licensing regulated procedures and for the improvement of the economic regime in place (polluter-pays principle; water resources taxes and recovery of costs) and definition of rules for exceptions, among others.

Implementation policies would make the River District Basin Plans more strategically operational and less prescriptive and evaluative, with measures clearly defined according to objectives. Ultimately, it would allow each water user to better understand how it relatively contributes to the water bodies' environmental objectives. Adopting cost-benefit analysis on measures, envisaging equitable and fair efforts, would contribute to a better engagement of stakeholders.

Also the need for legislation linking the different sectors for a sustainable management of water resources and removal of inter-sectorial legal conflicts (e.g. environmental and economic licensing), was mentioned. Improved articulated planning and management with Spain is also considered essential.

The formulation of implementation policies, a better joint articulation among the various planning instruments and the link between those plans and the program of measures, along with the involvement of the stakeholders in the planning processes, will allow Portugal to embrace the WFD paradigm.

In summary, it requires evolving from a governmental regulatory model to a water resources governance model.

Information on impacts of climate change

In the Tagus basin, and in Portugal, basic water related information exists spread out over several public and private entities (websites, etc.), but is considered not enough or not well updated. The lack of in-depth

characterization of anthropogenic pressures (quantitative and qualitative) and of the water bodies' status (insufficient monitoring) leads to deficient knowledge about the impact of pressures on water bodies, and therefore, impedes a comprehensive understanding of the water systems and nature of their problems.

Portugal has several state-of-the-art information systems (e.g. Water Resources National Information System - SNIRH) but some need to be updated or provided with additional information. Access to water quality data is considered easier than access to pressure characterization and impacts. It is not possible, at this stage, to relate how each water user contributes to the current water body status. Accurate public information on water uses is non-existent. As a result, the path to achieve environmental objectives cannot be clearly outlined.

Information about the evolution of climatic variables in Portugal is available at the website of the Portuguese Institute for Sea and Atmosphere (IPMA)[5].

While basic information for present impacts characterization is not considered to be enough, less knowledge exists about the impacts of climate change in water systems and in dependent economic activities, although several studies concerning climate changes have already been performed, such as the project "Climate Change in Portugal. Scenarios, Impacts and Adaptation Measures (SIAM)", with an integrated assessment of impacts and adaptation measures to climate change. The first phase of the study (started in 2000) was based on future climate scenarios derived from models of general circulation of the atmosphere and focused on a set of socio-economic sectors and biophysical systems including: water resources, coastal zones, agriculture, human health, energy, forests and biodiversity and fisheries. Also, a sociological analysis on the issue of climate change in Portugal was carried out. The second phase of the project SIAM (SIAM II) began in January 2002. It was focused on the case study of the Sado estuary, which are extended studies into the autonomous regions of Madeira and the Azores. The SIAM II also included the dissemination of the results obtained at SIAM I to various stakeholders, obtaining inputs still to SIAM II, through the organisation of meetings in which it participated teams in the sectors considered relevant for the chosen region and its stakeholders.

At sectoral level, part of water supply sector of the research site region (EPAL, a BINGO partner) has already been involved in research process related to climate changes. An example is the ClimAdaPT Local project, with the goal of developing, in Portugal, a continuous process leading to the elaboration of Municipal Strategies for Adaptation to Climate Change (EMAAC) and its integration in municipal planning tools. Another example is the PREPARED project, a predecessor of the BINGO project.

Aside from that, professional associations and scientific community have promoted numerous events regarding water management and climate change potential impacts, but they are considered too general and difficult to "translate" into concrete situations.

Better information is obtained by real observed impacts, such as upstream salt water migration in the Tagus River. However, it is difficult to know if it is due to Spanish discharge regime, to damming and national hydropower generation discharge regime, or to climate change.

[5] Portal clima, available online at: http://portaldoclima.pt/pt/.

It was mentioned that an easy, transparent and fast access to relevant updated data and information to all parties interested should be provided, allowing decisions and performance to be questioned and governance models to get more legitimacy. Access to information is recognised to play a key role.

Definition of the responsibilities of each intervenient in the characterization process must also be fully clarified and adequate resources allocated (financial, etc.). Inter-sectorial platforms should gather existing disseminated information, and make it available to all relevant organisms and agencies contributing to water bodies' status and management.

Knowledge of possible coping strategies

National and regional administrative entities on water resources are becoming older, having difficulties in recruiting and maintaining human resources. There is the need to outsource activities on a routine basis, such as, among others, monitoring. This type of routine procedure results in a high degree of dependence of the administrative entities on academic entities. This dependence on experts limits the administrative entities analytic skills, often leading to the use of simplified approaches. Besides, the administrative entities lack the knowledge and time for using integrated simulation models that are developed within the framework of studies promoted by the administrative entities itself, and recognised as being the right type of tool to support water resources management and conflicts solving.

Portugal has a competent and proactive scientific community in the area of water resources planning and climate change, as well as several active professional organizations with critical sense and advanced ideas about water sector management.

Regarding climate change adaptation, Portugal approved in 2010 the National Strategy for Climate Change Adaptation (ENAAC) with the following objectives: information and knowledge, to keep scientific knowledge up to date and available; reduce the vulnerability and increase the responsiveness in an integrated manner, define measures which Portugal must adopt, as the international community, with a view to minimising the effects of climate change; participate, raise awareness about climate change and its impacts; cooperate internationally, supporting the most vulnerable countries, in particular in the framework of the Lusophone countries.

The sectors of activity do not acknowledge this top-down strategy as they consider it detached from practical reality.

On the other hand, a set of adaptation measures is already being implemented by the main sectors of activity in lower Tagus region. In fact, they consider these measures as an adaptation to climate variability that always existed in southern Europe countries.

In the agriculture sector significant improvements in the products, techniques and technologies available to water use efficiency, fertilization and plagues control, as well as practices implemented ("precision farming") have already been achieved.

In the public water supply sector, EPAL has already internalized knowledge about the climate change risks, has adopted a risk management approach in company management and implemented a set of measures to face the current and future risk of decreased water quality and quantity.

There is a gap between the knowledge at academic level and the government's current practice. Moreover, in the Tagus region some water users from agriculture and public water supply sectors are well informed.

However, a gap between them and the administrative entities is also mentioned. As water management is centred at the administrative entities, with a top-down approach, these gaps do not contribute to smooth governance.

The decision making process should probably be improved and redesigned to match the proper knowledge level to each kind of decision-making. The institutional promotion of knowledge transfer from academic to the government agencies should be enhanced. Conditions should be created in order to guarantee that other stakeholders from the water supply sector, besides EPAL, internalize the knowledge produced in water management and of associated risks (e.g. climate change).

ENAAC is being reviewed since 2015 in order to promote and assist the various sectors, the central, regional and local governments and policymakers in finding the means and the tools for the implementation of the theoretical plan into the action plan, through a greater focus on efficient implementation of adaptation measures and promoting their integration in the various sectoral policies and territorial planning instruments.

Regarding mitigation, Portugal approved the National Program for Climate Change 2020/2030 (PNAC).

4.3. Institutional layer

Roles and responsibilities

Water resources planning and management are centred at governmental level with responsibilities prescribed in legislation.

At the **national** level, the central government (the Ministry of Environment, Regional Planning and Regional Development - MAOTDR) and the national water authority, the Portuguese Environment Agency (APA), are responsible for national water policy. Central government also bears responsibilities on dam security and on the coastline. The Directorate General for Agriculture and Rural Development (DGADR) is the National Public Irrigation Authority.

At the **regional** level, the five Administrations of River Basin District (ARH), that are decentralized services of APA, have the responsibility of assuring water management at the river basin district level, as well as the issuing of permits. The CCDR (Commission for Coordination and Regional Development) is responsible for protecting and enhancing water resources through territorial management. DRAP LVT (Regional Directorate for Agriculture and Fishery of Lisbon and Tagus River Valley) is the regional entity supervising private irrigation.

At the **municipal** level the responsibilities are only focused on conservation and rehabilitation of the hydrographic network, coastal zone and estuaries within urban agglomerations and on rainwater run-off drainage also in urban areas.

The majority of river basins in Portugal, such as Tagus, are dammed. Although water resources management in Portugal is public, centred in the Portuguese Environment Agency (APA) and their decentralised services (ARHs), the operation and exploitation of dam/ reservoir infrastructures is **outsourced** to the Electricity Company of Portugal (EDP), to the agriculture sector (some irrigation associations) and to some public water supply entities. Many reservoirs are multipurpose. The reservoir operation is not performed at the hydrographic basin level, but according to private sectorial objectives.

Conflicts of interests among the different users involved may arise, mostly during extreme weather events (floods or droughts), that need to be harmonized. The Reservoirs Management Commission (CGA) has the attribution of coordination of the planning and the exploitation of reservoirs. Its president is the president of the Portuguese Environment Agency. During emergencies, its Committee has enforcement power. The Tagus River Basin District Council – CRH (ensemble of entities), in practice, formalizes the public participation. The National Water Council (CAN) approves water resources policies.

In international basins, such as the Tagus basin, the water resources management needs to be coordinated between Portugal and Spain, which is accomplished through the Commission for the Implementation and Development of the Convention on Cooperation for the Protection and Sustainable Use of Luso-Spanish Water Watersheds (CADC).

Respondents mention the instability of the institutional framework, weakening agencies and their performance. They also mention the existence of overlapping responsibilities and conflicting rules. Despite the formal division of roles, inter-institutional cooperation is insufficient.

Therefore respondents mention the need for overcoming these weaknesses: providing greater stability of the institutional framework with an improved efficient model, eliminating overlapping competencies among entities, and improving an inter-institutional cooperative attitude among government agencies. Effectively engage stakeholders in planning processes, prior to decisions.

In summary, it is desirable to evolve from a government centred model to a governance model, in a clear and workable cooperation, defining not only the roles and responsibilities of the administrative entities but also of the water user's entities, envisaging a sustainable, balanced and equitable water use, while achieving environmental objectives.

Administrative resources

An institutional framework exists, although it needs improvement. Decentralized services at regional level facilitate the coordination, harmonization and integration of interventions, but they lack human resources. Portuguese law provides a set of planning and control instruments to achieve the goals for improvement of the water body's status. It also sets the priorities for water use in case of a crisis.

There are very advanced information systems (e.g. Water Resources National Information System - SNIRH), although not always provided up to date data. A monitoring network exists with data being publically available. There are difficulties in the practical application of the monitoring instruments due to lack of human and financial resources. Updated data in order to assess the state of the water bodies and the effectiveness of the measures would be an improvement.

Institutions should be provided with the tools and means to interact with stakeholders.

Integration of existing information's systems/ platforms from the government providing free and universal geographic information concerning water abstractions, water bodies' status, pressures, and meteorological information, etc. would constitute a great benefit.

The administrative entities miss an important tool, an integrated water simulation model, allowing for integrated management and use of the Tagus water resources.

Financial resources

The financing structure is assured through the Governmental financing of administrative entities; through the national Water Resources Protection Fund (FPRH), resulting from the Water Resources Taxes (TRH) revenues and permits, and through the European Union funding programmes that differ according to sectors of activity.

Governmental financing is insufficient, since administrative entities do not have the necessary resources to fulfil its monitoring, control, inspection and other obligations.

The Water Resources Protection Fund (FPRH) mission is to contribute to the rational use and protection of water resources, through the allocation of resources to projects and investments necessary for their best use. It is consensual the lack of public knowledge about the FPRH revenues and what is their application or destination or even if there is a real affectation to the water resources management and protection. This is also due to the major limitations and lack of transparency in the access to the FPRH.

Concerning national funds management (Governmental administration financing and FPRH), there is consensus that it raises a certain sense of discrimination. In fact, it is mentioned, that the deficient knowledge about the water bodies' status and the lack of orientation of the FPRH to protection measures, as foreseen by law, tends to be compensated by Administration through demanding the water users to implement measures, whose effectiveness is unknown.

The administrative organization of the water services has direct impact in governmental investment and access to funds. The Sector Delimitation Law (Law 88-A/97 of 25 July) introduced multi-municipal water systems and defined them as systems that serve at least two municipalities and require a predominant investment from the State for reasons of national interest (considering all others to be municipal systems).

Important suggestions regarding national funding are:

- Direct the Water Resources Protection Fund (FPRH) to the management and protection of water resources, in a clear and transparent way, as preconized in the legislation in force;
- Establish better criteria for access to the FPRH as, in practice, funding is decided on the basis of mitigation responses and unworked conflicts rather than on strategic objectives;
- Apply water services recovery costs proclaimed in Water Law and consider adjustment of rates (TURH /tariffs/ permit fees).

Concerning European Union funds suggestions are the following:

Agriculture sector:

- RDP2020 (EAFRD) finances investments in irrigation, water use efficiency and farming counselling are in place;
- Enhance the allocation of RDP2020 funds, if possible and necessary using alternative sources of funding (e.g. Juncker Plan);

Public water supply sector:

- Structural funding programmes of the European Union, as well as the European Investment Bank programmes, do ensure an important role in the financing of the sector;

- Cohesion Fund, in the PO SEUR, funds climate change adaptation and prevention and risk management;
- But it is necessary to remove existing uncertainty concerning access to EU funds, defining clearly who can apply to these funds (in the current programme funding allocation appears to be too based on legitimacy of the applicants).

The existing financing structure is adequate but poorly implemented. Suggestions provided in the questionnaires, if implemented, would result in more stable, transparent and fair access to funding.

4.4. Relational layer

Links to other policy sectors

Water policy is connected with other sectoral policies at the top level. Example is the Rural Development Plan - RDP2020, giving priority to investments located in areas susceptible to desertification.

At the bottom level some legal instruments for interfaces between the water policies and other policy sectors exist (mainly related to water taxes and regime of water use permits), but these are far from sufficient.

A good example of insufficient coordination is the difficulty of coordinating the River District Basin Plans with the planning instruments, on focus, methods and sectoral formulation.

Adequate coordination fails at different levels: society, in general, as deficit of cross liability with regard to water issues; deficient tradition of communication and articulation among different sectors; ambiguities due to the excess of instruments and regulations with sectoral character and the proliferation of plans related with territory and water management; insufficient technical grounds to justify why water policy imposing constraints, among others. Main suggestions are:

- Improve inter-agency cooperation and planning between water resources, land uses and sectorial activities;
- Reduce inter institutional bureaucracy;
- Manage interests and inter sectorial conflicts (e.g. electricity production versus agricultural seasonality or other sectors uses), manage different spatial planning perspectives, establish priorities, harmonize policies;
- Exploit the potential of compatibility between the conservation of natural resources and economic activities' practices;
- Regulate and implement the User Associations foreseen in the legislation,
- Make efficient the already existing Councils and Commissions;
- Improve the governance model and cross licensing procedures.

Transparency and public accountability

In general terms, transparency exists even if we can find from very good examples to less good ones.

A good example is the management of hydro agricultural infrastructures established through the application of the legal regime is an example of transparency in the management of water resources.

The lack of easy access to available information, especially the one related with the private use of water uses and the clear application of the Water Resources Protection Fund (FPRH) are common referred examples of lack of transparency.

To increase access to easily available information, the disclosure of reports (application of the FPRH and others) and the need for refocusing governance not on regulatory instruments of access and use of water but on communication tools for different users are some of the examples to improve participation with stakeholders.

There is a top down view of the administration that does not promote enough confidence in working together. Improvement suggestions are similar to those related to transparency and public participation.

The governance model should enhance strategic communication, involving all parties at a regular basis, Submit to the scrutiny of water users the important planning issues, in summary; adopt a multilevel approach, with formal power of political decision, after valuing the academic, technical and legal competences.

Participation

Consultation and participation is foreseen by law. Participation is formally supported through several Commissions and Councils (CAN - National Water Council; CRH - River Basin District Council; CGA - Commission of Reservoirs Management)

In practice, the participation of stakeholders takes place during the process of public consultation of the River Basin District Management Plans (PGRH) and Flood Risk Management Plans (PGRI).

Participatory decision/planning processes goes beyond presentations and platforms to submit proposals. Its goal is to enhance engagement and scrutiny. Therefore it should grow from an equally informed basis, that doesn't happen yet.

The weight of public institutions is considered too heavy and marked by the decision-making power or by the application of funding to allow for a real collaborative participation. Suggestions are:

- Provide the institutions with tools and means to establish channels of communication between the public administration and the water users;
- Engage in a targeted way the different stakeholders, enhancing their participation in the planning processes and measures delineation prior to decisions. Attend to their concerns, Manage interests and inter sectorial conflicts, establish priorities, harmonize policies consider and prioritize the different interest (e.g. electricity production vs. agricultural seasonality).
- Empower the River Basin District Council (CRH) with influence over the management decisions, make effective other councils as the National Council of Irrigation;
- Implement mechanisms of control and supervision of cross measures implementation accessible to all intervenient.

4.5. Governance strengths and weaknesses

The water resources governance analysis is affected by the sectorial perspective of the Portuguese case study, which addresses the adaptation of the public water supply and agriculture to climate changes.

Strengths

The main strengths lie on a good basis to depart from. Water resources policy in Portugal has a broad and sound national legal framework (Water Law) with several planning instruments at different geographical levels and at thematic oriented level. Mechanisms to deal with extreme events do exist, mainly floods but also droughts up to a certain extent.

Links between water policy and other policies are already formally present in law. At top level water policy is connected with agricultural policies, energy, sea, territorial planning, etc. Additionally, agencies with a competence in water management are present in different stages of land use policy formulation (Commission for Coordination and Regional Development - CCDR).

At sectoral level differences exist between the public water supply (PWS) and the agriculture sectors. Due to the existence of a Regulatory Authority on Water and Waste Services (ERSAR), Portuguese policy on water services have a global and integrated approach and include several instruments: adoption of strategic plans for the sectors (e.g. PENSAAR 2020 “A new strategy for water supply and wastewater services”); definition of the legislative framework; definition of the institutional framework; definition of the governance of the services; definition of the access targets and the quality of service goals; definition of the tariff policy; provision and management of the financial resources; construction of the infrastructure; improving the structural and operational efficiency; human resources capacity building; promotion of research and development; development of the economic activity; introduction of competition; protection, awareness and involvement of users; and provision of information.

Relevant differences exist between the agriculture sector benefiting from public irrigation schemes and private irrigation and rain dependent agriculture.

The water resources planning and management responsibilities are essentially public/governmental. Portugal has institutional organizations water resources oriented, structured at national level (national water authority - APA) and at basin district level. The division of roles and responsibilities is clearly defined by law and reflected in the different organizations that are active in water policy/management. These organizations have technically competent people.

An effort to engage water users in the planning process has started already. Stakeholder’s involvement is codified in law. Stakeholder’s participation is formally foreseen through several councils and commissions, and there is a platform for stakeholder discussion and cooperation.

In Portugal the ownership of water services is always public (from Municipalities or Central State) and the management can be done directly by the owner, by delegation or by concession.

Portugal has a tradition in the national water authority of making publicly available basic data on water quality monitoring as well as river flows and reservoir storage volumes. Portugal also has several state-of-the-art information systems (e.g. Water Resources National Information System - SNIRH) to enable consulting of that information. A lot of basic water related information also exist spread out by several public and private entities (websites, etc.), as ERSAR (Regulatory Authority on Water and Waste Services).

Stakeholders involved in BINGO project are well informed and aware of climate change concerns. They already deal with the climate variability typical of southern European countries. They see climate changes as an increase of existing climate variability either in frequency as intensity.

A set of adaptation measures is already being implemented by main sectors of activity in lower Tagus region. In fact, they consider these measures as an adaptation to climate variability that always existed in southern Europe countries.

In the agriculture sector significant improvements in the products, techniques and technologies available to water use efficiency, fertilization and plagues control, as well as practices implemented ("precision farming") have already been achieved.

In the public water supply sector, EPAL has already internalized knowledge about the climate change risks, has adopted a risk management approach in company management and implemented a set of measures to face the current and future risk of decreased water quality and quantity.

Portugal has an active scientific community as well as several active professional organizations with critical sense and advanced ideas about water sector management. They have promoted numerous events regarding water management and climate change potential impacts.

Portugal has a financing structure in place, based on European funding programmes and a national contribution, providing from the national Water Resources Protection Fund (FPRH), resulting from the Water Resources Taxes (TRH) revenues and permits, specifically targeting the use of water.

RDP2020 (EAFRD) finances investments in irrigation, water use efficiency and farming counselling are in place.

Structural funding programmes of the European Union, as well as the European Investment Bank programmes, do ensure an important role in the financing of the water services sector; Cohesion Fund, in the PO SEUR, funds climate change adaptation and prevention and risk management.

Weaknesses

The main weaknesses rely in the inability to fill the gap between the top planning and objectives setting and the bottom implementation.

Water resources policy has a top-down character. According to some respondents the legal national framework is complex and abstract, being is consensual that it lacks some concrete and operational implementation policies, strategies and mechanisms, mainly those concerning a sustainable, balanced and equitable water use. Sectors of activity refer in particular the absence of a comprehensive water uses policy and insufficient policy coordination to achieve the WFD goals.

The existing water management plans are not very well linked. Their articulation with sectoral plans is considered to exist at top level but not at local implementation level. Along with some missing implementation policies, result in river basin plans with very generic measures, not pragmatically and fairly oriented for objectives. There is also no control of implementation of measures.

It was also referred that different policy areas provide constraints for other policy areas. For instance, development of irrigation is constrained by nature policy, without technical or scientific backup. Environmental and economic licensing procedures are sometimes conflicting and not well articulated.

Water resources management in Portugal is essentially oriented to pollution control and emergency management. General practice is focused on immediate management priorities and not in long-term planning.

Although existing institutional organization water resources oriented, respondents refer the large instability of the institutional framework along time, weakening the agencies and their performance. Administration entities are short in human resources, having difficulties in recruiting and renovating human resources. There is need to outsource routine activities, developing a high degree of dependence of the administration from other entities (mainly academic) and limiting the administration analysis skills.

The top-down character does not promote enough engagement of water users in the planning process, prior to decisions. Participation of stakeholders, although formally arranged, is not effective enough. Stakeholders are not really engaged in the planning process or measures outlined. They are rather called to pronounce in a late stage of the decision process, with short time to do so. Some respondents also referred that their proposals and comments are often devaluated by administration. Interests of different sectors are divergent (for instance between agriculture and hydropower) mainly when resource are scarce, during droughts.

Public consultation is generally directed to civil society and not targeting sectors or stakeholders. Also, information is not sufficiently shared among stakeholders.

Although disposing of very good technological information systems (e.g. Water Resources National Information System - SNIRH) the existing basic data is considered not enough or not well updated. It misses in-depth characterization of anthropogenic pressures (quantitative and qualitative), of the water bodies status (insufficient monitoring), and therefore deficient understanding about the impact of pressures over water bodies. Public available information on water uses is inexistent. As a result, the path to achieve environmental objectives cannot be clearly outlined.

Administration misses an important tool, an integrated water simulation model, allowing for integrated water resources and uses management.

Regarding climate changes, the major concerns rely in the uncertainty about the extent of the impacts on the water resources, and therefore in the sectorial activities, and how fast the process will evolve.

BINGO stakeholders are quite aware, but the same level of awareness does not exist in all stakeholders of lower Tagus or in the country. The same happens with governmental entities that have not imbued yet a climate change risk culture in their activities.

Information about CC impacts is frequently considered too general and difficult to “translate” into concrete local impacts.

The sectors of activity do not acknowledge the top-down approach of National Strategy for Climate Change Adaptation (ENAAC), considering it detached from practical reality.

Financing is not enough at administration level to fulfil the monitoring, control, inspection and other obligations

Financing is also not always easily accessible at sectoral level, neither to the Water Resources Protection Fund nor to European funds.

As an example, is refereed that budget for self-control monitoring by water users is reduced, especially in the agriculture sector.

Also, the administrative organization of the water services has direct impact in governmental investment and access to funds. Multi-municipal water systems (at least two municipalities) require a predominant investment from the State for reasons of national interest. Single municipal systems are not covered.

It is unclear how the revenues of the Water Resource Tax are allocated, and not all stakeholders can find their way to European funding. Since most funding is not part of structural government budgets, it is not guaranteed for the future.

Governance needs (what can be improved)

Water legislation in Portugal could benefit from simplification and harmonization. It has a good legal framework but needs to develop the necessary policies, strategies, means and mechanisms to implement it, in order to achieve the environmental objectives and a sustainable, balanced and equitable water use.

Water uses policy is considered to be by respondents a very relevant missing component of the management process. It should be established based on an improved economic analysis of water uses (recognizing the economic, social and environmental importance of different types of uses). Once set, it would provide the basis for accordingly reviewed licensing procedures and for the improvement of the economic regime in place (polluter-pays principle; water resources taxes and recovery of costs) and definition of rules for exceptions, among others.

Better articulation between plans needs to be achieved, either at different geographic levels, as at water resources and sectorial articulation level and at environmental and economic levels.

Greater stability of the institutional framework should exist with an improved efficient model, eliminating overlapping competences among entities, and improving an inter-institutional cooperative attitude among Administration agencies.

There should be an increase in training of administration staff and strengthening of the administration resources at human, technical and logistics levels as for example integrated simulation models tools to support decision-making and conflicts management. More supervision, control and inspection and follow-up of programs of measures are also necessary.

Resources to improve knowledge of basic data (monitoring, pressures, and their impacts over the water bodies) need to be allocated, filling the existing gaps. Sharing of monitoring responsibilities between administration and water users needs to be improved in a fair and realistic way. Also, it was referred that an easy, transparent and fast access to relevant updated data and information to all parties interested should be provided, allowing decisions and performance to be questioned and governance models to get more legitimacy. Existing water uses is usually the missing relevant information referred, as well as other information allowing understanding the relative contribution of each water user to the water bodies' status. Access to information is recognised to play a key role. In this line, integration of existing platforms and information systems was also suggested, providing geographic information accessible to the public and stakeholders along with relevant information of licensed titles (water uses), existing constraints, etc.

Also, channels of communication between the public administration and users should be improved. Effective engagement of stakeholders in the planning processes, prior to decisions, needs to be worked out, evolving from a governmental regulatory model to a water resources governance model. The work/ intervention of the Hydrographic Region Council (CRH) should be enforced and published. It would allow a clear and workable definition of the roles and responsibilities as well as of the administration as of the water users, in particular in the design and implementation of measures for water body's protection and sustainable, balanced and equitable use.

Provide a more stable, transparent and fair access to funding. The application of the national Water Resources Protection Fund (FPRH) should be oriented to finance necessary and useful measures to a good water resources management and their destiny and access from stakeholders needs to be transparent and equally/ fairly accessible. The applications and procedures provided in European funs can be improved. For, example, by enhancing the allocation of RDP2020 funds, if possible and necessary using alternative sources of funding (e.g. Juncker Plan). in what concerns access to structural, cohesion EU funds remove exiting uncertainty, defining clearly who can apply to these funds (in the current programme funding allocation appears to be too based on legitimacy of the applicants).

Solving the water resources management basic issues contributes for the improvement of climate change adaptation.

Solely at individual entity level adaptation can only be accomplished up to a certain extent. The degree of rationalization of the use of water resources by each entity affects the other entities using the same water resources. Therefore, the next step towards a climate change adaptation requires linking of efforts in an integrated strategy and an optimization of water resources management among all parties interested in the same resources. In order to accomplish this, a way to overcome the disruption between top and bottom (administration and sectors of activity) needs to be found. As sectorial entities are already finding their paths, within their own fields of activities, it misses a governmental ability to overcome the gap between the top and bottom, starting by setting a real water management policy, including a water use policy, by establishing water resources allocation priorities according to the different types of uses.

Inter-agency cooperation would benefit adaptation efforts.

ENAAC is being reviewed since 2015 in order to promote and assist the various sectors, the central, regional and local administration and policymakers find the means and the tools for the implementation of the theoretical plan for the action plan through a greater focus on efficient implementation of adaptation measures and promoting their integration in the various sectoral policies and territorial planning instruments.

Regarding mitigation, Portugal approved the National Program for Climate Change 2020/2030 (PNAC).

A new Environmental Fund was recently created and will start being operated next January 2017.

In short, climate change adaptation requires shifting from a governmental regulatory model to an effective governance model, with all levels of society participation.

5. The Netherlands – the Veluwe

5.1. Introduction to the area[6]

The Veluwe is a forest-rich ridge of hills (1250 km^2) in the province of Gelderland in the Netherlands. The Veluwe features many different landscapes, including woodland, heath, some small lakes and Europe's largest sand drifts. Water abstractions provide ca. 2 million people with drinking water and further services industries, agriculture and nature.

The water system is vulnerable to droughts, which previously have led to a ban on overhead irrigation, a deterioration of water quality and insufficient good quality water for humans, nature and agriculture. Increasing droughts will have an effect on vegetation and soil composition, which will in turn influence groundwater replenishments. These effects are not accounted for in current models.

Table 5 – Overview of respondents in the Netherlands / the Veluwe

Organization	Respondent
Questionnaires	
Provincie Gelderland	Teun Spek
Provincie Gelderland	Britta Verboom
Waterschap Vallei en Veluwe	Almer Bolman
Vitens	Jan Hoogendoorn
Vitens	Jolijn van Engelenburg
Gemeente Amersfoort	Charles Rijsbosch
Expert-interviews	
Wageningen University	Robbert Biesbroek
Ministry of Infrastructure and the Environment	Olga Clevering

5.2. Content layer

Content of policy framework

There is a well-defined policy for current practices. The Province is responsible for groundwater sources and give permits for ground water abstractions. Source protection is sufficient for the current intake areas. The Water Boards have surface water quantity and quality policy. Municipalities have a “water paragraph” in their spatial policy and a sewage and drainage planning.

At the national level, climate change adaptation is primarily focused on water and governed by the Delta program. The Delta program focuses on water safety, availability of fresh water and spatial adaptation to climate change. The program aims to involve government and the private sector in concrete solutions to water related climate change issues.

[6] A more elaborate description of the research site can be found in D3.1 of the BINGO-project

Municipalities and Water Boards take climate change into account through “additions” of surface water volumes (or subtractions in case of droughts) to their current policy, but only within their own part of the system. This is only in the case of surface water, as far as the respondents know there are no new groundwater calculations. Also, Water Boards require municipalities to a apply a “water test” to their policies.

What is most notably missing is the integration of the policies of the different organizations in the water system. There is ample discussion about the workings of the water system and what policies would be beneficial (or not), but this does not lead to an integration of these policies. Also lacking is a systematic approach to incorporate climate change and climate adaptation into the water policy. An important objective, finding new regional drinking water sources, has not been translated into policy yet. Also missing are drought management plans.

Knowledge about the groundwater system should be improved and then translated into policy and planning. Also an integral and sustainable vision for the Veluwe water system should be developed. This has to be a vision that is shared among the organizations in the water sector and integrated with other policy fields.

Information on impacts of climate change

The main issue for the Veluwe is the response of the groundwater system to climate change, including increasing/decreasing precipitation and changes in vegetation. Therefore both information on potential long term droughts, changes in temperatures and knowledge about the response of the ground water system are necessary.

Climate change studies from the Dutch Meteorological Institute (KNMI) provide very comprehensive scenarios on the potential climate change in the Netherlands. They provide projections of potential long term developments in precipitation and temperature changes.

There is a lot of information about the groundwater system of the Veluwe. Vitens has long term measurements of the groundwater levels, which are very reliable. Municipalities have historic data on flooding.

Because of the limited activities in the underground of the Veluwe, it is still terra incognita. Also, a GeoTop for the eastern part of the Veluwe is missing. A new water system model is in place, AZURE, but it needs to be improved for evapotranspiration. Therefore, recent evapotranspiration data is necessary.

The water balance of the Veluwe is not fully understood, as well as the impact of climate change. More generally, knowledge on the impact of climate change on the Veluwe water system is not available, or not translated into tangible effects suitable for policy makers. Same goes for the effect of changes in the water system on stakeholders in the area.

Current knowledge could be used to develop a shared vision for the Veluwe water system. Based on that, stakeholders can jointly determine further knowledge needs. Policy decisions should be based on research. For the adaptation process, research should focus on the effects of climate change and the risks that it presents. That will encourage stakeholders to work together.

Knowledge of possible coping strategies

Knowledge about the Veluwe, climate change and adaptation is increasing. Throughout the whole of the Netherlands research is being done on water safety, quality and availability of fresh water. Also in other

sectors research is being done into adaptation strategies. However, this knowledge is spread out over different sectors and organizations.

What is missing is knowledge about groundwater recharge and who this is influenced by the geology of the Veluwe. Particularly the changes as a result of climate change are unknown. Knowledge of the entire water system is scarcely available. Employees with substantive knowledge of the Veluwe are becoming scarce as well (at the Province of Gelderland), which presents a threat. Also, the political will and capability to develop a shared vision, is lacking.

According to the respondents, knowledge and skills related to climate adaptation should be present at the responsible organizations. The Province of Gelderland and the Water Board should coordinate the development of a shared vision on the future of the Veluwe water system, with the participation of stakeholders and including climate change and adaptation.

5.3. Institutional layer

Roles and responsibilities

There is a formal division of roles and responsibilities between the province, the water board and the municipalities, but none of these organization is responsible for the groundwater system as a whole. The responsibility for the groundwater system is shared between water boards and province, but it is not always clear who is ultimately responsible. Roles and responsibilities are very much based on historical situations. Climate change and climate adaptation present issues that do not fall within the current boundaries.

There is a willingness to work together on climate change issues, but it is unclear who is responsible for new and cross cutting issues. New coalitions are in the making (for instance between Province, Water Boards and Municipalities), but as soon as they go beyond the water sector, coordination is more difficult. The province takes the lead in adaptation, but needs partners. Adaptation should be a shared responsibility of the stakeholders at the Veluwe, guided by a shared vision of the water system of the Veluwe. Tasks can be then delegated to the different authorities or stakeholders.

Administrative resources

The functioning and the protection of the water system are integrated into several policies by the Province and the Water Board. It is hard to say if that is sufficient for climate change adaptation, first because it is unclear how climate change will impact the Veluwe and what the effect on stakeholders will be. Second, because there is no clear way to assess whether adaptation is successful. How is adaptation measured? And how is robustness measured?

Also, the integration between water policy and environmental policy is insufficient. Adaptation should be part of an integral policy on the state of the Veluwe, including policy areas such as tourism, spatial planning, infrastructure, agriculture

Financial resources

There is funding for research and as a kick starter for adaptation, but not specifically for adaptation measures. According to the respondents, funding for adaptation should be coming from the current budgets for groundwater protection, environmental protection, water safety, etc. There should be no separate

adaptation budget, since adaptation should be an integral part of policy. For specific adaptation measures, funding has to come from stakeholders or specific government subsidies.

Improvement is possible by funding research that shows where problems due to climate change may arise and which stakeholders will be affected. This may create the necessary awareness to develop a joint program for adaptation. This program would consist of a shared vision on the issue and goals of adaptation and could be financed as part of the current budgets. For separate measures, different coalitions of stakeholders can be formed. Then, it can also be assessed if the current levels of funding are sufficient.

5.4. Relational layer

Links to other policy sectors

"On paper" the water policy is linked to other policy fields through the 'omgevingsvisie' (regional vision) of the province and the 'watertoets' (water test) of the Water Board. In practice, there is not much integration. Policy is developed through the 'do-not-harm' principle, where different sectors try to minimize negative effects to other sectors. This is still a long way from finding synergies. There are different interests between different sectors that are not easy to overcome. There is also a lack of knowledge within spatial planning about water issues and vice versa.

Improvement could be made by developing the next 'omgevingsvisie' jointly with stakeholders. Also research such as the BINGO-project could create awareness about shared risks and responsibility. The Dutch government has developed a 'Structural Vision on the Underground' (STRONG) which could be taken as a point of departure for a shared vision of the Veluwe.

The results from BINGO should be matched with the political ambition to provide useful outcomes for adaptation.

Transparency and public accountability

According to the respondents, there is sufficient transparency and accountability. All information about policy, as well as background documentation, is publicly available, also during the policy making process. Stakeholders have the opportunity to influence policy, e.g. by responding to policy initiatives.

However, the information is not always presented in a public friendly fashion. One has to intensely search in order to find all the relevant policy documents; in addition, one needs high awareness of the policy processes to be effectively involved. This goes particularly for relative 'outsiders' to the political process.

Participation

According to the respondents, stakeholders are sufficiently involved in the decision making around water planning, although municipalities are somewhat at a distance. The BINGO-project is a good example of stakeholder involvement. Stakeholder involvement is strongest in projects that take place in a specific area with concrete issues. Decision making with stakeholders on a broader level is more complicated.

There is insufficient focus on synergies between stakeholders. Public stakeholders eventually can find common ground in their public responsibility, but private stakeholders (justifiably so) are often more focused on their private interests. This goes for land owners, farmers, tourism, but also the forestry agency. Stakeholders should be more readily informed about expected nuisance, according to the respondents.

The province should provide a platform to facilitate discussion and translate the outcomes into policy. Trust of the stakeholders should be earned. Province and water board should connect more with the municipalities and get them involved in water policy.

5.5. Governance strengths and weaknesses

Strengths

The Netherlands has a strong tradition in water policy, with the water boards being the oldest democratic institutions in the Netherlands. Water policy is well institutionalized, with a clear division of responsibilities among the governmental organizations. The level of knowledge about water systems in general is high, and the Netherlands is leading in water research. Water policy is transparent, with sufficient information available to stakeholders and the public.

The KNMI provides easy accessible and comprehensive climate change scenarios, that provide a reference for all climate change related policies in the Netherlands.

The national Deltaprogramma is a comprehensive and provides guidance for regional and local stakeholders to work on climate and water related issues. It provides kick starter funding to local and regional stakeholders to set up initiatives that benefit water safety, water quality and the availability of fresh water.

Weaknesses

There are three main concerns with regard to climate change adaptation. Firstly, there is insufficient knowledge about the impact of climate change at the Veluwe and how it will affect stakeholders. Therefore, it is difficult to convince stakeholders of the urgency of climate change adaptation. This makes coordinated efforts difficult, because stakeholders don't see the need disregard their own interest in favor of climate change adaptation.

Secondly, water policy is, in practice, not very well integrated within the water system itself and with other policy fields. Respondents indicate that a vision on the whole water system is lacking. The lacking integration of water policy with spatial planning is also reason for concern. This separation is strongest at the national level. There used to be a coordinated spatial planning in the Netherlands, but that is now more or less abandoned and left to lower levels of government. Instead of a long term vision for the whole of the country, a more locally oriented problem solving approach is now dominant.

Thirdly, climate change adaptation is overall not at the forefront of the debate. The National Adaptation Strategy that was recently passed by the Dutch parliament is not as powerful as the Delta program, as it lacks legislative and regulatory instruments. The Delta program, albeit a strong program, has a primary focus on water related issues, with 'spatial adaptation' and playing just a minor role. Despite the encouragement in the EU Climate Adaptation strategy to develop a holistic vision to adaptation, such a vision is lacking in the Netherlands, which was also noted in an audit by the General Audit Chamber of The Netherlands.

Governance needs (what can be improved)

Climate change research in the Netherlands is very much focused on water. This should be expanded to other sectors as well (Health Care, ICT, Transport) to obtain a broader risk assessment. At the national level, this is challenging, since government departments are highly specialized and often have opposing views

and interests. At the regional and local level, this should be easier, because the effects of climate change become more tangible.

Research such as the BINGO-project could lead to more knowledge and awareness of the impact of climate change at the Veluwe. These impacts can then be addressed as a shared challenge for the stakeholders and allow for more cooperation and coordination. This should be done based on a shared vision of the Veluwe in which different policy areas are integrated. Adaptation should not be incidental, but integrated into the regular operations in the area.

6. Germany – the Wupper River Basin

6.1. Introduction to the area[7]

The Wupper River Basin is located in the state of North-Rhine Westphalia, Germany, with an area of 813 kilometres and a population of approximately 950,000 inhabitants. The Wupper is an upland river with a length of about 115 kilometres, rising in Marienheide-Börlinghausen (Oberbergischer Kreis district) and flowing into the Rhine River at the city of Leverkusen. The Wupper River and its many tributaries form a river network of ca. 2,300 kilometres. The Große Dhünn Reservoir – the second largest drinking water reservoir in Germany – is located within the Dhünn River catchment area, one of the main tributaries of the Wupper River.

The Wupper Association is responsible for water quantity management and quality of all water bodies within the Wupper River Basin. As a public body, the Wupper Association performs its tasks in the public interest and for the benefit of its association members: town councils, local and district authorities, municipal water suppliers, and effluent disposal businesses, trade, and industrial organisations in the catchment area of the Wupper River. Their contributions cover the costs of wastewater treatment with sewage sludge disposal, flood protection, managing water flow during dry periods (raising low water levels), water supply provision, and maintenance and ecological development of rivers and streams. Close cooperation allows also for the identification of water management strategies. The Wupper Association operates twelve reservoirs, eleven wastewater treatment plants, numerous storm water tanks, and flood control reservoirs.

[7] A more elaborate description of the research site can be found in D3.1 of the BINGO project

Table 6 – Overview of respondents in Germany / the Wupper River Basin

Organization	Respondent
Questionnaires	
Bezirksregierung Düsseldorf	Matthias Ufer
Stadt Wuppertal	Hubert Nobis
Stadt Solingen (Umweltplanung / Untere Bodenschutzbehörde)	Peter Vorkötter
Stadt Remscheid (Fachdienst Umwelt)	Monika Meves
Oberbergischer Kreis (Umweltamt)	Heinz-Gerd Stosiek
"WSW Energie & Wasser AG (Planung Stadtentwässerung)"	Christian Massing
Wupperverband	Dr. Marlene Liebeskind
Landwirtschaftskammer NRW	Heinrich Spitz
Currenta - Leistung für Chemie und Industrie	Günter Müller
Technische Betriebe der Stadt Leverkusen AöR (TBL)	Thomas M. Klein
Technische Betrieb Solingen (TBS)	Tycho Kopperschmidt
Expert-interviews	
Wupperverband – Department of Forestry	Torsten Klingenhoff
Landesamt für Natur, Umwelt und Verbraucherschutz Nordrhein-Westfalen (LANUV)	Bernd Mehlig

6.2. Content layer

Content of policy framework

With regard to water management within the Wupper basin, there exist several water policies in Germany, not only at federal state level but also at EU level, such as the EU Water Framework Directive. There are also policies linking water management to different areas such as agriculture and forestry, among others, even though they might not be directly considered as water policies or laws. There is the Water Resources Act (WHG) and the individual water acts of the respective federal states (LWG). Besides, there are different regulations which own legal character and administrative regulations which are compulsory to the internal administration.

There are strategies for preventive measures in flood protection available, but the willingness to develop a general strategy on water management appears to be missing. Threat and vulnerability maps are being developed, but some respondents would also like to see an enhanced database and more reliable predictions of extreme events. The exchange of information and experience through workshops works well, but information and counseling for building owners (based on finalized simulation) is missing. Although there is active work on climate adaptation, energy management and CO_2 savings, a better protection of drinking water catchment by the district council is missing.

To improve the content of policy, basic climate change data have to be included in consultative documents and rules for action. Also a model approach and an interconnection between different policy levels is recommended.

Information on impacts of climate change

Error! Reference source not found. shows that most respondents consider the amount of information not, or only partial, sufficient. Available tools, strategies and data comprise ongoing research projects on climate change, well defined flood plains and flood paths models in preparation. The KOSTRA-atlas (Koordinierte Starkniederschlags-Regionalisierungs Auswertungen (coordinated regional analysis of heavy rainfall) provides rain series for the past years and the design criteria for water management are based on decades of experiences and data. The main tools available with regard to flood protection are warnings by the DWD (Germany's National Meteorological Service) and a weather information system for civil protection (FeWIS). Furthermore, there is data available regarding flood areas, flood risk maps and flood hazard areas.

Also, the necessary plans, know-how and skills and training for flood protection are available. According to the respondents a more forward looking approach could be useful, in the form of climate scenarios, integration of climate change effects in the determination base. Also, in light of climate change, the available information for the catchment area should be regularly updated. There is a need for more concepts for climate change adaptation and these concepts should be coordinated between the regional and municipal levels. Also reliable forecasts of future consequences of climate change in relation to water management have to be produced.

Suggested improvements are:

- reliable forecasts of future consequences of climate change in relation to water management
- setting clear goals regarding climate change (including responsibilities, action plans and time lines)
- information created worldwide from different research institutes should be processed yearly from an public and official authority

Knowledge of possible coping strategies

Most respondents consider the available knowledge and skills to be partly of fully sufficient. The Wupperverband has flood warning plans available and the necessary plans, know-how and skills and training for flood protection are available. Mandatory guidelines should ensure that climate change is properly considered in decision making on water management. As the impact of climate change is uncertain, continuous sensitization is necessary. It is often mentioned that climate adaptation concepts are missing. Improvement can be made by discussing and coordinating possible reactive measures on climate change.

6.3. Institutional layer

Roles and responsibilities

According to some respondents, there are clear responsibilities within the municipalities regarding water management. Others consider this to be insufficient. According to them a municipal coordination of competences and responsibilities is missing. This can be caused by a lack of clear statements by the ministry about responsibilities for flood protection. They suggest that responsibilities should be more clearly defined for accountability to be ensured. For some respondents this could go as far as a precise task assignment

for every person in charge. A more centralized, coordinated approach to climate change adaptation is also suggested, with a climate change officer acting as a coordinator of climate adaptation efforts at all levels.

Administrative resources

A majority of respondents consider the administrative resources to be sufficient. What is missing is a transfer or discussion of the results of climate change research in the context of urban development. Consultative documents and rules of action as legal basis have to be adjusted to changes in weather patterns. With regard to water management, stakeholders outside the water industry could benefit from a presentation of water management tools and methods. According to most respondents this is sufficient, although a more precise forecast of floods based on broader data can be beneficial.

Financial resources

There are several financing systems available for water management in the context of climate change such as financing for structural improvements through the Water Framework Directive or regional plan financing. Finally, project financing is provided by the federal state of North-Rhine Westphalia. Interviewees mention a need for a climate fund that specifically addresses climate change. Also, support in program management and an overview of relevant programs would be useful to help organizations obtain funding.

Respondents are not in agreement about the sufficiency of the financing systems (**Error! Reference source not found.**). Suggestions for improvement entail

- application of fee revenue for climate change adaption
- clear definition of what measures should be financed through fees or through other means
- improvement of Water Framework Directive to reduce bureaucratic burdens and costs

6.4. Relational layer

Links to other policy sectors

Respondents are positive about the interdisciplinary cooperation on several levels and the communication on a personal level. The participation of the Wupperverband in land use planning is also considered strong. The integration of the Wupperverband water policy with the water economic master plan of Solingen is also recognized as important. The publication of flood maps is considered an important factor in order to reach a decline of flood stress. A coordinated approach of flood crisis management between different sectors is currently being discussed.

However, respondents also mention a need for better communication and exchange, for instance with the fire department. Sometimes, understanding and consideration of different concerns are missing (e.g. by the department of land use-planning). The Wupperverband would benefit from a regular information exchange of stakeholders, that coordinates the municipal climate adaption concepts, or even a central agency coordinating all stakeholders and measures.

Most respondents consider the links to other policy sectors to be partially sufficient (**Error! Reference source not found.**). Suggestions for improvement are

- expansion of the integrated planning process for climate change adaption in the water management

- information (websites, fact sheets) for investors to visualize all concerns
- comprehensive institutionalization of collaboration
- more connections (better network)

Transparency and public accountability

Transparency is achieved by information exchange regular conferences, internet and intranet. There is adequate transparency inside the water management system, transparency for outsiders is given by environmental reports for major projects. Planning is transparent and many parties are involved (process can take 2-5 years), planning is almost always optimally coordinated. However, the long duration of planning is mentioned as an issue. A simplified planning could be useful. As improvement, a coordination of water economic management requirements is suggested. Also, the increasing bureaucracy and the amount of surveys are mentioned as a problem.

Participation

The stakeholders recognize the good involvement of stakeholders within water management. Conferences, meetings and round tables are regularly organized and encourage information exchange in the context of river area management. However, there is disagreement among the respondents whether the information exchange among stakeholders is actually sufficient. For taking action in measures with non-clarified responsibility/financing, an enhanced decision making process would be needed. Another way of coordinating demands of different stakeholders is the appointment of a climate protection officer. The good personal contacts and regular meetings have built a certain level of confidence among the stakeholders. This is clearly reflected in the positive outlook for future cooperation (**Error! Reference source not found.**). For the future, a clear division of labor would be recommended. Improvements can also be made by sensitization of members of parliament and the continuous work on a framework regarding flood risk management and flood protection.

6.5. Governance strengths and weaknesses

Strengths

The confidence among the stakeholders to work together on climate change issues stands out as a strong suit for Wuppertal. This is in part because the personal relations and communications are well developed. Water policy in the Wuppertal is well integrated with other policy fields. Land use planning is mentioned as a successful example, as well as the integration with the water economic master plan of Solingen.

Also, the respondents feel that a wide range of tools is available to tackle current climate risks, such as floods. The professionals who deal with these issues have the right knowledge, skills and training to do so. In addition, the publication of official flood maps is thought to have actually reduced the stress on affected areas.

Transparency is considered as a strength by the respondents. They are informed about the regular conferences that are organized on water management and feel up to date about new problems and developments in this field.

Weaknesses

The Wuppertal lacks a comprehensive, coordinated strategy to deal with future climate change. There seems to be a lack of climate adaptation concepts, some respondents mention the lack of a general discussion/strategy on climate change adaptation. Although personal relations and communication are well developed, some respondents mention the lack of information exchange among stakeholders with regard to climate change adaptation. For instance, building owners are insufficiently informed about their risks.

This can be caused by a lack of knowledge about future climate change. Respondents mention that scenarios of climate change effects on the Wupper Basin and more reliable predictions of extreme weather events are missing. This also makes it hard to work on climate adaptation.

Finally, the duration (2-5 years) and bureaucratic nature of the planning process is mentioned as a weakness.

Governance needs (what can be improved)

The Wuppertal would benefit from a systematic inclusion of climate change adaptation in all layers of governance. For the content layer this means developing a general, coordinated strategy on climate change adaptation. This requires more specific knowledge about the future state of the climate in the Wupper Basin and the effects that it has on the different stakeholders (institutional layer). This knowledge then has to be implemented in mandatory guidelines (for instance for urban planning) and clear strategic goals, including responsibilities, action plans and time lines. Also, respondents suggest to introduce a financing scheme (through fees) specifically to finance climate adaptation.

For the relational layer, the primary improvement would be the coordination of climate change adaptation among different stakeholders and different levels of government. This could be done by expanding the integrated planning approach for climate change adaptation, create better networks and comprehensively institutionalize the collaboration on climate change adaptation. One suggestion is to appoint a climate change officer to coordinate climate change related activities among the stakeholders.

7. Norway – Bergen city

7.1. Introduction to the area[8]

In Norway, the BINGO research concentrates on the city of Bergen, Norway's second largest city with 270.000 inhabitants. The city is located on the shadow of the mountain Løvstakken. Currently, the lower-lying parts of the city, close to the sea, are going through a big transition where industrial areas are replaced by residential areas. Within the BINGO project, the research concentrates on the hilly area of Damsgård in particular.

Known for its rainy climate, heavy precipitation loads pose a major threat to Bergen city. With a closed water system, the city is at risk of flash floods. In addition, because the sewer and stormwater system are not fully separated, there is a risk of Combined Sewer Overflow (CSO). The discharge of CSO's into the subjacent fjord Puddefjorden may cause risks to the health of people living close to the fjord and the environment that surrounds it.

The future risks to the system are strongly linked to climatic changes. If climate change causes more extreme weather, such as heavier precipitation events, there is an increased risk for flooding and flash floods. Also, sea level rise is a growing concern, especially for the lower areas (close to the sea) where new developments are currently taking place.

This chapter elaborates on the results of the questionnaires and expert-interviews on policy and governance context for adaptation to climate change in Bergen. The questionnaire was filled out by representatives from the water utility (Bergen K, main partner in the BINGO project) and one representative from the research partner in Norway (NTNU) in a mini workshop in the beginning of June 2016. This was followed up by an interview in the beginning of July 2016. In addition, the results of two expert-interviews held in October 2016 are integrated.

Table 7 – Overview of respondents in Norway / Bergen city

Organization	Respondent
Questionnaires	
Bergen K	Magnar Sekse
Bergen K	Marit Aase
Bergen K	Ivar Kalland
Bergen K	Hogne Hjelle
NTNU	Erle Kristvik
Expert-interviews	
Policy-maker at the Norwegian Environmental Agency	Herdis Laupsa
Senior researcher within the Regional Climate & Climate Services and Climate Dynamics departments at Uni Research,	Erik Kolstad

[8] A more elaborate description of the research site can be found in D3.1 of the BINGO-project

7.2. Content layer

Content of policy framework

In Norway, water management is regulated at the national level but implemented at the local (municipality) level. The Norwegian Water Resources and Energy Directorate (NVE) provides guidelines and recommendations regarding water management and flood risks. These are followed strictly by the municipalities.

In Bergen, the municipality has a well-defined municipal master plan which reflects the politics in the city. This plan is structured such that the part of the municipal plan that deals with spatial planning also contains master plans for sewer and water quality management (see Figure 1).

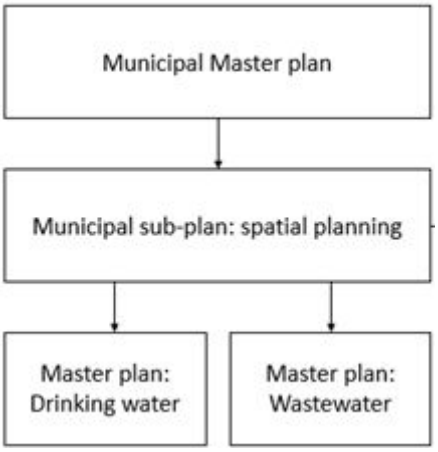

Figure 2 – Structure of the municipal master plan

For the risk associated with the runoff of stormwater, no master plan has been devised. However, the municipality has issued a guideline document that specifies how stormwater could be handled.

Information on impacts of climate change

The Norwegian Centre for Climate Services (NCCS) collects data on changes in the Norwegian climate. While much information has been collected and interpreted, more research is needed to fully understand the impacts of climate change in Norway. For example, changes in short-duration high-intensity rainfall and its consequences are associated with large uncertainties.

Also, effort has been put in making the information from global climate models available on the local level. To this end, climate “profiles” are being developed for each county in Norway, which intend to explain in a simple manner how local meteorological and hydrological variables will be affected by climate change. Each county will have its own profile by the end of 2017.

In Bergen, questionnaire and interview respondents identify a strong record on information about precipitation. Historical recordings of rainfall patterns date back to over 30 years. However, respondents also fear that this focus on historical data diverts attention away from the potential future impacts of climate change on the water system in Bergen; how does climate change impact on the risk of flash floods and CSO in the city? In addition, respondents feel that new risks have been insufficiently explored. Storm water

presents a new threat to Bergen and the lack of data with an appropriate level of detail hampers a good understanding of this risk in the region. According to the respondents, a huge potential lies in better linking different sources of data (e.g., on precipitation and stormwater runoff patterns). Incorporating these linkages in modelling activities can help to better understand the systemic nature of climate-related risks.

Knowledge of possible coping strategies

At the national level, the white paper "Climate change adaptation in Norway" (Meld.St.33 2012-2013 Report to the Storting) is the main document on climate adaptation. The principle of sectoral responsibility forms the foundation of the white paper. Local authorities (municipalities) are most affected due to the local character of climate change impacts, and because municipalities are responsible for protecting their inhabitants from natural hazards, they are seen as key responsible authorities for dealing with climate-related impacts.

Coordination of climate change adaptation takes place at the national level. The national government offers grants to finance local adaptation solutions and provides information on climate change impacts and adaptation options. Also, the Norwegian Environmental Agency is working on capacity building and contributes to the implementation of adaptation policies. The Ministry of Climate and Environment and the Norwegian Environment Agency share a coordination responsibility for climate change adaptation. Recently, a climate bill has been proposed which includes a reporting commitment on climate change adaptation to monitor the adaptation process.

A challenge to effectively organize climate change adaptation at the national level, according to the respondents, is that the information that is available on climate change does not structurally trickle down into the lay-out of water management. For example, the guidelines for water management issued by the NVE do not incorporate climate change as a structural factor. To the extent that the directorate provides additional information on climate change impacts to communities, this information provision has a random and non-binding character. While information provision should be improved, there is no law requiring communities to act on the information they receive about the impacts of climate change. Up to now, this has resulted in a varied adaptation landscape, with some communities (mostly those affected by a hazardous weather event in the past) having invested heavily in adaptation measures, whereas others have taken almost no steps in this regard.

In the city of Bergen, some adaptation efforts are currently being undertaken. The water utility company has taken on the task to separate the sewer and storm water systems, with a long term goal of separating 4km per year. While this is a good effort, respondents feel that this pace will be insufficient to deal with the potential impacts of climate change. Furthermore, respondents highlight that stormwater is not integrated in the municipal master plan. Besides the guidelines document, there is no long-term plan that envisions a strategy on how to deal with stormwater in the city.

While strategic plans have been formulated for dealing with drinking water and sewage water and their associated risks, the policy framework in Bergen generally lacks the specification of tactical and operational plans. Existing plans are formulated at the strategic level, but they need detailing into the tactical and operational level. Such detailing can help to embody strategic plans with practical instruments that ensure the implementation of strategic plans.

7.3. Institutional layer

Roles and responsibilities

In general, responsibilities for water and adaptation governance are decentralized in Norway. Because the precise risks vary per region, municipalities are generally held responsible for dealing with climate risks. As a consequence of this decentralized governance structure, the level of organization for adaptation governance in the water sector also varies across Norwegian regions.

At the local level of Bergen, roles and responsibilities for the daily management of drinking water, sewer water and stormwater have been well defined through the municipal master plan and the stormwater guidelines issued by the municipality. However, respondents identify a need to clarify responsibilities for dealing with future climate-related risks. In many cases, it is difficult to determine who should bear what part of the risks that Bergen faces.

An example of this is the case of closed vs. open stormwater solutions. In case of constructing a closed system, where infrastructure is constructed for the purpose of stormwater handling, responsibilities in terms of implementation and financing are clear: Bergen K, the water utility company, has the resources to finance these kinds of constructions. However, for natural and open solutions for stormwater management, responsibilities are less clear. While recent Norwegian Supreme Court rulings clearly state that open solutions should in fact be considered stormwater measures, no agreement on responsibility has been obtained so far. One recommendation offered is to further develop this option in a strategic municipal master plan, which also outlines an appropriate responsibility structure.

Administrative resources

Because of the decentralized governance structure for water and adaptation governance in Norway, adaptation to climate change displays huge regional variations. This regional variation could only increase when climate change continues to be addressed as a local policy problem. While there are resources for national coordination of adaptation efforts, there are little national-level capacities to enforce adaptation measures at the community level.

Financial resources

With clearly laid out responsibilities for existing water management practices in Bergen, the financial structure that supports these practices is generally well-arranged. A problem arises with respect to the financing of new adaptation solutions, needed to address the additional risks climate change puts on the region. For example, open stormwater solutions may provide valuable adaptation options for Bergen as it allows retaining increased stormwater runoff while also benefitting environmental management. However, as was also addressed in a recent Norwegian Official Report (NOU) on stormwater (NOU 2015:16), responsibilities have not been defined for these types of open stormwater measures. Consequently, these solutions are not covered by the financing system. While the national government offers grants for the implementation of adaptation measures, no structural sources of funding have been earmarked in the national and local water management budget to ensure the implementation of new adaptation solutions such as open stormwater systems.

7.4. Relational layer

Links to other policy sectors

While at the national as well as at the local level strong links have been made between water governance and spatial planning, respondents generally feel that adaptation presents a more holistic challenge that requires the creation of a more integrated governance approach. Climate change affects all sectors, and adaptation measures have to provide solutions that work in all these sectors. For example, better links could be established with key infrastructural policy fields such as roads, transport, and railways. In a similar vein, open stormwater systems require stronger links between the policy fields of environmental and water management.

In Bergen, the municipal master plan makes a strong connection between water handling, area planning, and risk assessment. To some extent, this organization of the master plan ensures a clear connection between spatial planning and water policy. However, linkages are predominantly addressed at the strategic level and challenges remain for the practical implementation of strategic plans. When it comes to design and sub-planning there is often not enough time for each field to find an optimal interdisciplinary solution. An example of this is that the water engineer often starts his work after the landscaper is finished. Because of this, it is difficult for the water engineer to propose open stormwater solutions (which are aspired) as the surface area is often already planned.

Transparency and public accountability

The transparency of water governance in Norway is generally considered high. Because of the decentralized responsibility structure, water and adaptation policies are formulated within public authorities that are easily accessible to the public. However, with respect to adaptation governance, the policy framework is less clear. As responsibilities have not been assigned to specific risks, it is also not clear which authority can be held accountable for responding to the impacts of climate change.

Participation

At the national level, some key stakeholders are involved in formulating adaptation strategies and plans. For example, the insurance sector has become active in this field, as it fears high damage claims due to climate-related events. However, climate change affects much more sectors, and more could be done to increase the awareness about the potential impacts of climate change in these sectors and their possible contributions to responding to these impacts.

In Bergen, cooperation and stakeholder involvement is easier to organize in smaller sub-projects and plans than in the process of formulating bigger (strategic) plans. Challenges related to stakeholder involvement may be caused by diverging interests, but often also have to do with limitations of resources and time. The latter might be solved by communicating stakeholder participation opportunities at an earlier stage. Generally, the involvement in projects such as BINGO is considered a good arena to learn about and improve water governance in Bergen. Focusing on a specific area of Bergen (the Damsgård area), the BINGO project is not only beneficial with respect to learning from other similar sites (e.g. Badalona) but also in an inter-regional context where there is much to learn about stakeholder involvement.

7.5. Governance strengths and weaknesses

Strengths

Key strengths of the Bergen policy and governance context lie first of all in the content layer of water governance. Information on water-related risks is well-organized and much effort has been put in disseminating this information to local governance levels where the main responsibilities for water management are allocated.

Second, in the institutional layer, responsibilities for water management are well-arranged, with general guidelines specified at the national level to ensure a basic quality, which can be tailored to local-level characteristics and needs by county and municipal governments.

Third, in the relational layer of water governance, strong links have been created between water management and spatial planning.

Weaknesses

Key weaknesses of the Bergen policy and governance context are threefold. First, the information on weather-related risks is based on historical data recordings. Less is known about the future conditions, and the threats these conditions pose on (the different regions in) Norway.

Second, information that is available is not translated in the existing policy framework on water management. While information on climate-related impacts is increasingly collected and analysed, this information is not linked to binding actions in official policy documents and laws on water management in Norway. Up to now, climate change adaptation is merely incorporated in strategic plans at all levels (white papers, master plans), but actual responsibilities for adapting to the impacts have not been assigned.

Consequently, third, the actual implementation of adaptation solutions is difficult to realize. There is huge regional variation in adaptation governance throughout Norway and because of a lack of enforced implementation, the necessary links between water management and other sectors that are affected by climate change are not made. Because of this, opportunities to develop and implement effective integral solutions for climate change adaptation are currently missed.

Governance needs (what can be improved)

In summary, there are three main governance needs (which are linked) to improve the organization of climate change adaptation in Bergen's policy and governance context. First, there is a need for better risk and vulnerability assessments that provide insight into the future risks climate change poses to the water system in Bergen.

Second, adaptation policies need to be included in the policy framework on water management, especially for stormwater. While responsibilities for water management are decentralized in Norway, respondents identify a need to take on some responsibility for adaptation at the national level. At the national level, the NVE could include adaptation governance in its guidelines for water management. Also, information about the impacts of climate change could be provided on a less voluntary basis, for example by requiring communities to take appropriate adaptation measures based on the information they receive. To support such actions, Norway could greatly profit from its decentralized responsibility structure in water governance,

where management guidelines are formulated at the national level to ensure equal starting conditions but which can be adapted to local conditions to support the development of effective regional solutions.

At the level of Bergen city, respondents recommend to develop a strategic stormwater plan and include it in the municipal master plan, as outlined below in figure 2.

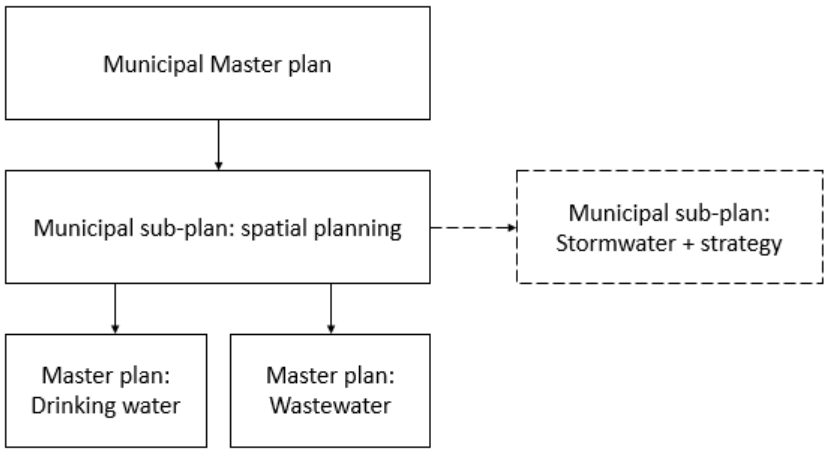

Figure 2 – High-level description of the structure of the Municipal Master plan. Dashed line indicates the needed stormwater and strategy plan.

Third, when responsibilities for climate change adaptation have been better addressed in the policy framework for water governance, connections between different policy fields may also be strengthened. Such increased bonds will increase knowledge and cooperation, through which effective adaptation solutions can be developed and implemented.

8. Spain – Badalona city

8.1. Introduction to the area[9]

Badalona city is located along Spain's northeastern coast. It belongs to the province of Barcelona, which lies in the region of Catalonia. Over the years, as the city of Barcelona extended its space claim, this megacity has grown onto Badalona and now it is part of the Barcelona Metropolitan Area. Badalona lies directly adjacent to the Mediterranean Sea, it is bordered by the Besos River in the west and surrounded by the steep Serra de la Marina Mountains in the northeast. The city covers over 21 square kilometers with an altitude difference of almost 500 meters running from the mainland down to the sea. It is one of the most densely populated cities in Catalonia with 220.000 inhabitants. Its almost 5km of Mediterranean beaches offer a popular tourist destination. Together with income from commerce and shipping at the harbor, tourism is an important economic driver of the city.

Characterized by steep differences in altitude (high slopes in the upper parts and flat areas in the lower parts), Badalona is vulnerable to problems with drainage. Urban flash floods and combined sewage overflows (CSO's) already resulted in more than 125 million euros of claimed insurance damage in 1999 and present a major threat to water quality and tourism. Being a sea-front city makes Badalona also susceptible to coastal flooding. In 2000, 80 million euros was claimed after a coastal flood. At the same time, the city faces risks related to periods of drought. Its water resources are limited and drought not only challenges the supply of water (scarcity) but also the quality of the water sources. Climate change may increase all these risks in Badalona city.

In Badalona, the BINGO questionnaires and expert-interviews were coordinated by research partner Aquatec. The table below lists the organizations and respondents who filled in the questionnaire (9) and the experts who were interviewed (3) for this research site.

[9] A more elaborate description of the research site can be found in D3.1 of the BINGO-project

Table 8 – Overview of respondents in Spain / Badalona city

Organization	Respondent
Questionnaires	
Urban Drainage Director of Aquatec (Suez Advanced Solutions)	Pere Malgrat
Badalona City Council	Pep Montes
Badalona Marine Studies Center (Escola del Mar)	Xavier Seglar
Badalona municipal laboratory	Maria Lluïsa Forcadell
Badalona Harbour	Imanol Sanz
AMB (Metropolitan Area of Barcelona)	Llorenç Alerm
Drainage and Sewers Director, Aigües de Barcelona	Juan Carlos Ruíz Cabeza
Polytechnic University of Catalonia (UPC), expert on urban drainage	Manuel Gómez
University of Barcelona (UB), expert on water economy	Montse Termes
Expert-interviews	
Institute of Science and Environmental Technologies (ICTA) at the Autonomous University of Barcelona (AUB)	Xavier Gabarrell Durany & David Saurí
Spanish Office of Climate Change (OECC) of the Spanish Ministry of Agriculture, Fishing, Food and Environment (MAPAMA)	Eduardo González Fernández

8.2. Content layer

Content of policy framework

In Spain, there are a number of general framework policies and laws that guide water management. There is a water law which incorporates the most important water regulations. Also, a National Hydrological Plan has been forwarded by the Ministry of Agriculture, Fishing, Food and Environment (MAPAMA) to secure Spain's main water resources against future threats like climate change. Its implementation runs through regional river basin management plans. In addition, there is a law (21/2013) that arranges for environmental impact assessments for developments and projects with a huge impact on the environment. Besides these regulations, a Spanish Office of Climate Change (OECC) has been set up under the auspices of the MAPAMA which has received the status of a directorate-general in 2006. The OECC coordinates all actions in the domain of climate change mitigation and adaptation. For adaptation, the office has formulated a National Plan for Adaptation to Climate Change, which aims to integrate ('mainstream') adaptation into the policy frameworks of all those sectors vulnerable to climate change and which was adopted in 2006. It also coordinates impact assessments of climate change on water resources in Spain.

At the regional level (Catalonia), water management lies in the hand of the Catalan Water Agency (ACA), a regulatory agency for water management operating under the Catalan government. This agency is responsible for the planning and managing the complete water cycle in Catalonia, except for the parts of Catalonia that belong to interregional catchments. These catchments are the responsibility of the National Government and are governed through MAPAMA. The ACA is responsible for implementing the European Water Framework Directive (WFD) in the part of the region not belonging to interregional catchments, and in this line has developed water management plans that target regional catchments and their water courses. Wastewater treatment is another pillar of the agency. The ACA has contributed to the development of an

urban wastewater treatment plan, which aims to improve the quality of surface water through a number of regulatory and technological measures and actions and administers a water reuse program for Catalonia. The agency also monitors flood risks in the region.

At the metropolitan level, the public administrative entity the Metropolitan Area of Barcelona (AMB) governs the territory of Barcelona and 35 adjacent municipalities around the city. The AMB is responsible for the provision of public services in the area, including territorial planning, transport and mobility, urban development and housing, environment and the water cycle, from drinking water supply to wastewater treatment and reclaimed water production, economic and social development, and social and territorial cohesion. The AMB owns large parts of the urban drainage infrastructure (pipes, inceptors) and coordinates the links between this infrastructure and local sewage systems and Waste Water Treatment Plants (WWTP). The administration works with 'master plans' that set out the general policy framework for the management of different provisions. It for example has a stormwater master plan for the implementation of an urban drainage network in the Barcelona metropolitan area. It also coordinates drinking water supply of the different utilities that operate in the region.

The work of the AMB is supported by Aigües de Barcelona, a public-private company that manages the technical infrastructure for water services in the metropolitan area, from catchment storage to drinking water treatment, transport and supply. It is also in charge of the Waste Water Treatment Plant (WWTP) that services Badalona (the Besòs WWTP), together with 6 other WWTPs located among the metropolitan area of Barcelona, by making sure wastewater is suitable for return to the environment or reuse (in some cases).

At the Badalona city level, the municipal government manages the drainage network in order to guarantee its correct functioning. In Badalona, there is a Master Drainage Plan from 2012 for Flooding and Combined Sewage Overflow (CSO).

In general, the planning of water management in Badalona is strong. Plans have been specified for different aspects of water management. However, respondents are concerned about the fragmented nature of the policy framework, with different aspects of the water system being covered by different laws and regulations and governed by different agencies. In general, they therefore call for a more integrated policy and management approaches at the regional level to better coordinate between its different parts and improve the coherence of water governance. For example, a regional master plan for drinking water supply could help to establish a more efficient governance approach in which the existing infrastructure in the region is more effectively tailored to the regional demands for drinking water (both regarding quantity and quality).

Information on impacts of climate change

Technical information about the current state of the water system is well organized. However, respondents also note that current knowledge about the technical state of the water system and its management depends largely remains 'insiders knowledge' as it too much depends on the people currently working in the sector. Furthermore, as management responsibilities are fragmented, this knowledge is scattered over the governance field as well. Existing knowledge is not well recorded or stored, and is therefore not easily accessible to the relevant sub-sectors of water management. In addition, existing knowledge focuses primarily on the regional level. Information about the performance of local water networks or local demands for water, for example at the city level, is hardly available.

While there is good information on the state of affairs in water management, respondents notice a lack of knowledge on future risks. For example, the risks of flooding and droughts have been quite well researched, because these risks already affect two key economic sectors in the region: agriculture and tourism. However, fewer resources are allocated to analyzing the potential risks that face water management in the future. For example, the factors that influence water quality (e.g., microbiology behavior) in the water system are less well-known. Respondents generally stress the importance of obtaining new data on climate change and its possible impacts in the region and the city, to build awareness about the future risks facing water management in Badalona.

Knowledge about possible coping strategies

Recent initiatives demonstrate an increased awareness of the impacts of climate change and an increased willingness to invest in adaptation measures. At the national level, climate change features centrally in important water management policies (e.g. the National Hydrological Plan) and initiatives (e.g. the set-up of the Spanish Office of Climate Change and the formulation of a National Plan for Adaptation to Climate Change). At the regional and local level, some adaptation measures have actually already been taken. Several retention tanks have been built along Barcelona's seaside (one also in Badalona) to store water in case of a storm flood. Also, some new technologies have been implemented to use underground water and reclaimed water (water reuse). In addition, in the Catalonia region, a couple of desalination plants were constructed.

However, the general feeling is that these new initiatives remain rather small to medium-scale and are not sufficient to deal with future climate risks. In addition, they remain focused on the already existing risks of droughts and flooding. The adaptation measures that have been developed up to now deal with periodic droughts, water scarcity and floods but problems like CSO are just recently being addressed in the policy framework (RD1290/2012), and apart from the few storm tanks, no real measures are being developed in this area. While more storm tanks are needed to alleviate the sewer system in Badalona (as concluded in the last Drainage Master Plan of 2012), respondents also call for a more diverse and complete risk management strategy to deal with CSO's. In this respect, some respondents characterize the existing governance arrangement as reactive rather than proactive, as innovative actions are usually only approved when problems have already occurred. They miss long-term visions and plans that anticipate possible future changes and risks for Badalona.

Another problem identified with adaptation strategies is that different adaptation measures are currently being developed in different segments of the water sector, each to deal with the particular risk in that segment. For example, beach control and sewer management are governed through separate strategies. As a consequence of this governmental fragmentation, people working in the water sector are often unaware of policies developed outside of their organization. For example, there is a policy to ensure the supply of drinking water under adverse conditions, but many people are unaware about this policy. Because of this, opportunities to synchronize adaptation policies are missed.

8.3. Institutional layer

Roles and responsibilities

Despite being complex, the roles and responsibilities of different agencies involved in Badalona's water management have been clearly defined for different levels of governance. In general, each party is also well aware of its responsibility in water management and acts on its allocated duties. However, there are many regulators, public and private, involved in water management. While responsible parties know what their own roles and responsibilities are, they often know too little about the responsibilities of others.

Up to now, this fragmented governance structure has been insufficient to manage the current water system. However, most respondents think this structure will be still more insufficient to deal with future risks, for which responsibilities have not been assigned. There is a lack of ownership for future risks which means that no preventative action is taken. And if anything goes wrong, no one can be held responsible. As climate change brings forward new risks in the water system, this responsibility "void" could become lager.

A more holistic and integrated approach could be set up, according to the respondents, through which different elements of the water system can be overseen in an integral way. It could be used to better spell out who is responsible for the management of possible future risks in water management, and to specify who should pay for adaptation strategies and through what means. Such an approach is especially deemed important to react to the impacts of climate change.

Administrative resources

With responsibilities being distributed over so many different (public and private) actors in Badalona, respondents identify a lack of coordination in the different parts of water management. What does not help in this respect is that knowledge in this sector is scattered across different segments and poorly recorded. This hampers the interaction between responsible agencies in water management and efforts to coordinate between its parts.

In addition, while legislation and planning on water management in Badalona is strong, their enforcement can sometimes be difficult. For example, while environmental law poses strict requirements on the quality of surface water, there are still open drains to the sea and the riverbed, because of which these quality standards are difficult to uphold in practice. Besides more money to modernize the underground water infrastructure, improved coordination between sewage planning and quality control are important to develop effective adaptation strategies.

In line with their call for more integrated regional policy approaches, respondents also call for a better administrative coordination of water management. When more administrative resources are geared to coordination, opportunities for collaboration between different levels and sectors currently working in water management can be identified. As a positive example, the integration of different drinking water utilities into one public-private company (Aigües de Barcelona) is mentioned; this integration has greatly improved the management of the whole water cycle in the metropolitan area.

A concrete recommendation is to install a committee to interpret the legislative and regulatory context of water management in the Barcelona metropolitan area. This committee could also be given the task to collect and organize information on water management and make it accessible, and to facilitate a better coordination between different actors and departments. This would establish a structure to support the

development of integrated adaptation solutions. Another suggestion is to create a specific water department in the local administration of Badalona to improve administrative oversight on water management in Badalona.

Financial resources

Respondents generally agree that the drinking water supply in Badalona is backed by a sufficient amount of funding. This funding is secured through drinking water charges, which are approved by the AMB and collected by water companies, and are based on consumption (in contrast to the fixed rates that used to be charged and are still charged in some Spanish cities). These rates generally cover the costs of ensuring an adequate provision level, but do not include the costs of environmental or water resources management called upon by article 9 of the WFD. However, because the ACA is an active facilitator and advocate of wastewater treatment and sanitation facilities in the region, some respondents identify a conflict of interest which could potentially undermine the funding of drinking water supply, especially in the long run when more investments need to be made to prepare the drinking water supply for the impacts of climate change. Separation of the task to promote sanitation and wastewater treatment on the one hand and to function as the regulatory body in water management on the other within the ACA is proposed as a possible solution. In fact, nowadays, ACA is developing a draft of a new Water Law in Catalonia to solve this.

For wastewater treatment and water reuse, no taxes are charged. Financing is secured through funds the AMB or the ACA directly appropriates from the Catalan Government. This funding has been drastically reduced over the last couple of years as a result of the economic crisis. A solution mentioned by respondents is to create a tax for the financing of water sanitation (treatment and purification). However, some respondents also underscore that the costs of adaptation in Badalona´s water sector may be too great for the community to bear. In this regard, some respondents think the WFD could help to improve the financial structure underlying water management in Badalona. This EU policy requires that for the users of catchment areas, pricing policies are developed to ensure the sustainability of the water system.

8.4. Relational layer

Links to other policy sectors

While in the development of national-level adaptation policies, stakeholder collaboration has been organized, in Badalona, there is a lack of interaction between different responsible agencies in water management. This lack of interaction not only characterizes the domain of the water sector itself, but also interactions between the water sector and other sectors. In particular, respondents argue that the spatial planning sector is insufficiently involved in water management in general, and in adaptation to climate change specifically. It is important to involve urban planners in the development of water plans, and vice versa, to involve water specialists in urban developments, in an early stage of the process to ensure water is taken into account in the development of urban plans. Better links between urban planning and water management are seen as particularly valuable for the development of strategic plans at the regional level. The ACA but also Badalona City Council is seen as a suitable party to take the lead in this.

Water has an important social component, as clean and safe drinking water and good sanitation are basic needs of humanity. In Badalona, this social component is anchored in water policies and some actors as AMB are working on it. For example, drinking water policies explicitly aim to ensure public accessibility to

the drinking water supply by making sure drinking water is reasonably priced. However, continuously rising drinking water charges – needed to secure the stable and sound delivery of drinking water – may cause affordability problems in low-income neighborhoods/households.

Transparency and public accountability

Due to its fragmented structure, Badalona´s water governance context is not very transparent. Many people who are not involved in water management are unaware of both the set of (public and private) regulators and administrators involved in water management in Badalona, and of the specific duties of these parties. Because of this, public actors also do not know which agency or agencies can be held accountable for different water management tasks.

Respondents generally agree that more effort should be put in communicating water management to the public. As a first positive step in this direction, the new Transparency Agency that has recently been created at the metropolitan level is recognized, and reflects the increased political interest in the issue.

What hampers such efforts to increase public transparency, as several respondents notice, is the political nature of water management in Badalona. Political aims often blur technological and rational-economic debates about the costs and benefits of water management. They call for a more technical approach in which choices are based on a rational consideration of costs and benefits and which can therefore be clearly explained to the public, although some respondents also emphasize that you need political will and support to move ahead with water management.

Public participation

While communication to the public can be improved, respondents also feel that public participation could be improved, too. At this point, water management still largely lies in the hands of official governmental organizations. Although some regional river basin management plans have been developed in close cooperation with area stakeholders, respondents generally feel that more could be done to involve particularly end-users. Information campaigns (which are now often technical) or flooding and CSO alerts can help to increase the awareness of end-users – as the last link in the chain of water management – of the importance of good water management and their possible contribution to it. However, some respondents are also a bit wary of giving stakeholders a large say in water management policies. It runs the danger of politicizing water management only more, while there is also a need for a more technically-oriented approach.

At the same time, many measures that could be considered as ‘adaptation measures’ have not actually been officially forwarded as such. For example, water consumption has been effectively reduced through information campaigns. However, these campaigns were justified from the viewpoint of sustainability or environmental conservation and not explicitly linked to climate change.

8.5. Governance strengths and weaknesses

Strengths

One of the major strengths of the Badalona governance context is its strong and well-defined policy framework for water management. The policy framework covers all relevant aspects of water management.

In each of these subdomains, existing problems are well known and the context is well understood. Policies therefore outline appropriate tasks to deal with these problems. .

Most respondents also feel that this policy framework is backed by a strong legal and administrative planning structure, with well-defined responsibilities for current water management tasks.

In addition, technical knowledge about the current water system is also available to responsible parties. In Badalona, actors are aware of their responsibilities in water management but not always have the resources (financial and technical) to act on this.

Weaknesses

A major point of weakness in the Badalona governance context lies in its fragmented structure and incomplete funding, especially for urban drainage system. Responsibilities are clearly defined and assigned, but they are fragmented over different governance levels and actors and there is little oversight or monitoring on the sector as a whole. Because of this, some critical linkages between different sub-sectors of water management (e.g. sewer and beach management) are currently not made. Furthermore, existing water management practices are underpinned by an incomplete financial structure, because it lacks a municipal sewerage tax and also because financial contributions to water sanitation have been sharply reduced in recent years.

A second major weakness is the focus of current water management practices on the existing situation. There is no structural consideration of the potential future changes and risks instigated by climate change in the governance context. This implies that no responsibilities and resources (financial, administrative, knowledge) are assigned to deal with these future risks, but also that if something goes wrong, no one can be held responsible and parties look at each other to provide a solution.

Both weaknesses may actually reinforce each other. While climate change is a structural factor in national-level policy documents such as the National Hydrological Plan and the National Adaptation Plan, as well as in national-level initiatives such as the set-up of the OECC, these exertions do not easily trickle down to the regional and local level where governmental fragmentation hinders cross-sectoral collaboration. With little monitoring and oversight, parties will continue to only operate within their limited set of responsibilities and risks that impact on the system as a whole will not be anticipated.

Governance needs (what can be improved)

Three governance needs can be identified. First, there is a need for more knowledge about the impacts of climate change on the different sub-sectors of water management in Badalona and the water system as a whole. This would help to increase awareness about the possible detrimental effects on the water system and help to better anticipate these effects by developing new adaptation policies.

Second, there is a need for more coordination in Badalona's water management. This coordination would not only help to create better links between the different sub-sectors of water management at different levels of governance (city, metropolitan and regional level), but also to establish important links between the water sector and other sectors, such as spatial planning.

Third, there is a need for a new governance style that is anticipatory rather than reactive and for policy measures that target long-term developments rather than the existing situation. Increased awareness and better coordination could be the first steps to realize this change, together with the suitable funding

framework that nowadays is not enough to cover all the necessities arising from the water cycle management, especially to those related to the urban drainage system.

9. Comparative analysis

9.1. Introduction

This report described the policy and governance context of the six European research sites that feature as case study areas in the BINGO project. The aim was to identify the main governance strengths and weaknesses for adaptation to the hydrological impacts of climate change in these regional contexts, in order to develop targeted recommendations for implementing the adaptation strategies that developed by the local Communities of Practice at each research site in a later stage of the BINGO project.

Empirically, the focus was on six regional contexts: the Peristerona watershed in the Troodos Mountains at Cyprus, the Wupper River basin in Germany, the Veluwe area in the Netherlands, the lower Tagus river basin in Portugal, the city of Bergen in Norway, and city of Badalona in Spain. With this broad focus, the BINGO project allows to identify region-specific as well as general governance strengths and weaknesses for adaptation to climate change in Europe. To structure the analysis, use was made of the Three Layered Framework for water governance, which distinguishes between a content, an institutional and a relational layer.

The region-specific challenges have been elaborated on in the previous chapters of this deliverable. In this concluding chapter, these challenges are comparatively analyzed. It identifies major points of divergence in regional governance contexts, as well as common governance challenges, for adaptation to climate change in the different EU countries.

9.2. Cross-case governance strengths

What stands out from the analysis is that overall, existing water management practices are well organized at the different research sites. This becomes visible in all layers of the framework for water governance.

In the content layer, the policy and governance arrangements fit the specific contexts of the six BINGO research sites. The frameworks generally cover relevant aspects of water management at these sites (e.g., flood risks, water quality, waste water, beach management). With the exception of some specific subdomains, actors generally feel that existing policies address the most important contemporary issues in water management. In addition, relevant information is collected to support water management in these different subdomains. Responsible actors have access to the information they need to perform their daily management tasks.

Regional policy frameworks for water management are usually backed by strong institutional arrangements. For the different subsectors of water management, tasks and responsibilities have been clearly outlined and allocated to different actors, at least formally. Overall, administrative resources are also well organized and tailored to these tasks. There is sufficient capacity to implement water management policies, there is sufficient monitoring capacity (e.g., on the price and quality of drinking water), Portugal being the only case where there is substantial concern about monitoring, and in most cases, water management is supported by an adequate financial structure that ensures a long-term and stable source of funding for existing water management practices, but not necessarily climate change adaptation.

Because responsibilities are well-defined and allocated, water management at the research sites is generally transparent and open to public inquiry. The existing organizations of water management therefore provide

for a necessary amount of public accountability. Also, particularly in Germany and in Norway, links between water management and spatial planning are being developed.

It should be noted that for the subdomains of irrigation and groundwater management, policy frameworks seem to be less well organized. In these subdomains, responsibilities are often unclear and sometimes overlap, and a good financial structure is not guaranteed. These subdomains tend to be characterized by a high degree of self-organization, which, on the positive side, has positive effects on the degree of stakeholder participation in these domains.

9.3. Cross-case governance weaknesses

In this report, several weaknesses in the regional governance contexts have been identified.

What stood out first from the analysis is that the policy contexts at the research sites insufficiently take future climate risks into account. Existing policies display a clear focus on contemporary challenges in water management. For example, droughts have always been a major problem in Cyprus, thus there are strong policies to deal with water shortages on the island. In the Dutch lowlands, floods and water quantity management have always been the highest priority. Because of this strong focus on present-day challenges, the future risks posed by climate change are insufficiently incorporated in existing policy frameworks. In Bergen city for example, risks related to storm water are not yet addressed in the municipal policy framework. One of the causes underlying the strong focus on contemporary problems in regional water management connects to a lack of information about the regional impacts of climate change. While different actors are aware of climate change in general, the impacts are only understood on a global level and there is little data on how climate change affects different aspects of the water system in different localities.

As a consequence of the present-day focus in regional water management contexts, climate adaptation policies in the BINGO regions tend to target historical risks. For example, in Cyprus climate change is mostly linked to increasing water scarcity and as a result, existing policies in this field are strengthened to deal with this increased risk. In the Netherlands, climate change adaptation is incorporated under the header of water management, while climate-related water quality and health risks remain untreated. At the same time, it should be noted that these adaptation policies remain highly strategic; the importance of adaptation is particularly emphasized in strategic visions and policy lines at higher levels of governance, but the translation of these visions in actual adaptation policies is difficult in all regions. Because adaptation policies are mainly formulated at a strategic level, clear adaptation targets have not been specified, responsibilities have not been defined, and structural financial resources have not been allocated to address new risks of climate change adaptation.

Another governance weakness is the high degree of fragmentation that characterizes existing water management practices in the regional governance context. At the six research sites, different subdomains of water management are governed by different actors and through a different subset of policies. In Cyprus, Spain and Portugal, drinking water, irrigation, waste water and flood risk management are for example dealt with under separate policies and by different responsible agencies. Because of this, information about the water system and its current performances is also scattered across different subdomains of water management. This hampers the coordinative capacities of the management system.

A related weakness lies in the lack of collaboration, not only between the different subdomains of water management but also between water management and other sectors such as spatial planning,

environmental management, agriculture, and tourism. In some regional governance contexts, links with other sectors (mainly spatial planning) have been established, but in general, linkages could be improved. Also, a lack of stakeholder participation was identified. While the structural integration of stakeholder participation varies across regional governance contexts, overall, but problems were experienced with the involvement of new types of stakeholders in water management, such as end-users or the private sector. It is difficult to organize participation of these new stakeholders because they are often not fully aware of the impacts of climate change on their own operations, and because they often have conflicting interests.

9.4. Cross-case governance needs and challenges

Assessing these governance weaknesses in the context of climate change adaptation at the six research sites, three main governance challenges can be identified.

First, a common challenge seems to lie in incorporating new climate change risks in the existing policy and governance framework, and in developing and implementing adaptation measures to deal with these new risks. The specific nature of this challenge varies across research sites. In Badalona, the policy framework is strongly oriented towards the existing problems of droughts, water scarcity and floods but the risk of CSO's is insufficiently recognized. And in Bergen, drinking water and wastewater are well managed, but no policies have been developed to deal with the increased risks posed by storm water. However, the general characteristics of this governance challenge are similar.

This challenge can be addressed by establishing a more anticipatory governance setting, which is able to look beyond contemporary problems in water management to the new risks posed by climate change. To facilitate this change, more information about the specific impacts of climate change at the regional level is needed, which should be disseminated to actors and agencies that are responsible for or work within the water system.

Second, there is a need for a more holistic governance approach. Climate change not only affects water management but a whole range of sectors and actors. Therefore, stakeholders from different sectors need to be involved in the formulation of adaptation solutions. Also, better links should be established between the different subsectors of water management (e.g., storm water and waste water in Bergen, or beach management and water quality management in Badalona) to effectively deal with climate change risks. To establish a more holistic approach, the governmental fragmentation that currently characterizes regional water management should be reduced and regional coordation should be improved to enlarge integrative capacities of water governance.

Third, the effective implementation of adaptation measures should be strengthened. To this end, institutional resources need to be organized for climate change adaptation. Policies should define adaptation targets for the treatment of different risks, and allocate responsibilities, and administrative and financial resources accordingly.

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Annex I – Template of Questionnaire

BINGO Questionnaire on policy and governance

Layer/Question	What do we have that works	What is missing?	How can water governance be improved?
Content Layer			
Is there a clear policy and planning for water management?			
Do we have sufficient and relevant information?			
Do we have the necessary knowledge and skills?			
Institutional layer			
Are the roles and responsibilities clear?			
Do we have the necessary tools?			
Is functioning of the financing system ensured?			
Relational Layer			
Is the water policy well connected with other policy fields (e.g. spatial planning)?			
Are all stakeholders involved in decision making for water management?			
Is there transparency in water management?			
Is there enough confidence to work together?			
Risk management			
What are the **current** risks your water system is facing?			
Do you feel these are dealt with sufficiently?			
Which measures are already in place?			
What **future** risks are you currently aware of?			
Do you feel there is sufficient preparation to deal with these?			

Annex II – Structure of Expert-interviews

A. Introduction

- Introduce yourself: name, organization, function.
- Explain BINGO project: aims, focus (hydrological impacts), expected results.
- Explain WP5.3 and aim of the interview: WP5.3 assesses the existing policy and governance context for adaptation to climate change-related impacts at the research sites and makes recommendations for improvement per site (and beyond). The interview serves to grasp the national-level policy and governance situation and to identify its strengths and weaknesses for adaptation to climate change.
- Explain research site details: which types of risks are central.
- Explain practicalities. Interview will last about 1,5 hours. If needed: Interview will be recorded for personal use.
- Explain structure interview: question address three themes: the content of adaptation policies for water management, its organizational aspects, and the policy culture.

B. Questions related to the content of adaptation policies for water management

1. What are the **main national policies and laws guiding water management** in your country? What type of policy instruments are used to govern water management (e.g. legal/regulatory, market-based/pricing, information provision)?

2. Is **information** on the **hydrological impacts** of climate change sufficiently available to responsible actors? What impacts are understood, which impacts are still largely unknown?

3. To the extent that these impacts are known, is there sufficient information on how to deal with these impacts in relevant (sub)sectors? For which risks have **adaptation measures** been devised, which risks remain (partly) "untreated"? What type of policy instruments are used for climate change adaptation?

C. Questions related to the organization of adaptation governance

4a. In **general**, how is water management organized in your country? Are **responsibilities** largely governmental or are private sectors (also) involved? Is water management characterized by a top-down or decentralized responsibility structure? Are the roles and responsibilities of different parties clear?

b. For **adaptation** policies in particular, have responsibilities for implementing adaptation policies been outlined clearly? Which actors seem to carry the bulk of responsibility for climate change adaptation up to now, and which actors could potentially take on more responsibility?

5a. In **general**, is water management in your country backed by sufficient **financial and administrative resources**?

b. For **adaptation** in particular, are policies supported by sufficient financial and administrative resources, and how does this impact on their implementation?

6a. In **general**, is water management in your country **linked to other policy sectors**? In what way – what do these relationships entail?

b. For **adaptation** in particular, do adaptation policies require new or stronger linkages with other policy sectors? To what extent have these linkages been made?

D. Questions related to the policy culture in adaptation governance

7. In general, what **norms and values** underpin water management in your country? (E.g. technocratic, bureaucratic, integrative/intersectoral, collaborative, etc.)? Do similar principles underlie adaptation governance?

8. Are **stakeholders** sufficiently involved in adaptation governance? Which stakeholder-groups are involved, and in which phases (e.g. goal-setting, policy development, implementation of policies)? Are there stakeholder-groups that have not been involved sufficiently?

9. Would you describe the adaptation governance in your country as **transparent**? To what extent and in what way can responsible parties be held **accountable** for their adaptation tasks (e.g. are adaptation goals legally anchored, do responsible actors have reporting duties, etc.)?

10. Is adaptation governance your country confronted with **equity** issues (e.g. in relation to land-use entitlements or the allocation of water(-related) resources)? To what extent do you think existing adaptation policies sufficiently recognize and deal with these issues?

E. Closing remarks

- Ask if there is anything the respondent would like to add to the interview.
- Thank the respondent for his or her time.
- Explain further steps: interview will be worked out in a report, report will be sent back to the respondent for a final check (please respond before October …), after which it will be send to KWR (deadline is October 15, 2016).